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TWENTIETH VOLUME.

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NATIONAL CAR AND LOCOMOTIVE BUILDER

DEVOTED TO THE INTERESTS OF RAILWAY ROLLING STOCK.

R M. VAN ARSDALE, Proprietor.

ANGUS SINCLAIR, Editor.

PUBLICATION OFFICE:

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JANUARY, 1889.

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The Chicago, St. Paul & Kansas City will build 1,000 new cars.

A contract shop for the building of freight cars is about to be erected at Tyler, Tex.

The car shops of McKee, Fuller & Co., Catasauqua, are building 2,000 coal cars for the Lehigh Valley Railroad.

The Milton Car Works, at Milton, have an order for 500 box and 500 coal cars for the New Jersey Central Railroad.

The Lafayette (Ind.) Car Works are at work on an order for 100 refrigerator cars, which will keep them busy for some weeks.

The St. Charles Car Co., of St. Charles, Mo., has just received an order from the Union Pacific for 15 chair cars and two suburban coaches.

Mr. A. G. Staat, superintendent of the Hutchinson, Kan., Street Railway Company, has distinguished himself by eloping with another man's wife.

The Georgia Railroad Company have made recent additions to their works at Atlanta, Ga., putting in new machinery from a western firm.

The big Car Works Company, at Anniston, Ala., have contracts for 6,000 new cars for next year, and expect to use 10,000,000 feet of lumber in their construction.

The Barney & Smith Manufacturing Company, of Dayton, O., has been awarded a contract to build 500 box cars and 500 coal cars for the Chesapeake & Ohio road.

A. Whitney & Sons, of Philadelphia, have contracts for about 7,000 wheels for new cars. They are also doing a large business in small wheels for mining purposes.

The St. Charles Car Company, St. Charles, Mo., are making extensive additions to their plant, and have purchased considerable new machinery.

In the car department of the Baltimore & Ohio shops, at Mount Clare, Baltimore, they are building three new postal cars, with frames of pine 60 feet long. They are putting vestibules upon all the cars used for through trains.

The annual statement of the Wagner Palace Car Company to September 30 shows: Gross receipts, $2,595,209; increase, $76,202; expenses paid, $1,964,915; increase, $140,091.

The Pole-Road Locomotive Company has been chartered at Richmond, Va., to manufacture pole-road locomotives. The officers are: R. A. Lancaster, of New York, as president; William H. Lucke, secretary and treasurer, and J. A. Yancey, general manager.

The Chicago, St. Paul, Minneapolis & Omaha road has received three new Pullman sleepers for use on the vestibule trains between St. Paul and Minneapolis and Chicago. The cars are elegantly finished and furnished, and have all the latest improvements for comfort and luxury.

The Jacksonville, St. Augustine & Halifax River Railroad Company have lately had seven new day cars and two parlor cars built at Wilmington, Del. They are very handsome cars and are finished in mahogany and have the most approved furnishings and conveniences.

A handsome dining car which cost $18,000 was recently completed for the Canadian Pacific road at the Crossen Car Works at Coburg, Ont. The seats are covered with Russia leather and the sides of the car on the interior between the windows are covered with plate glass mirrors.

The Southern Pacific Company is building a 60 × 100 feet addition to its shops at Sacramento, Cal., which will be used for a brass foundry, spring shop and locomotive stock and sheet iron work departments. Other improvements are also being made which will enlarge the capacity of the works.

The United States Rolling Stock Company, who are building large car works at Anniston, have finished grading for their blacksmith and machine shop, which is to be 90 × 500 feet. They will add to their works a large plant for manufacturing car springs that will employ several hundred hands.

The New York Elevated Railroad Company are about to order twenty-five new locomotives of their standard pattern. They are Forney engines, and weigh 46,000 pounds in working order. All engines have to be made from the company's drawings and specifications, and the parts must be strictly interchangeable.

A dispatch from Stevens Point, Wisconsin, says the master car builder of the Wisconsin Central line has received orders to mark all cars repaired and rebuilt "Northern Pacific," instead of Wisconsin Central. This is taken as a sign that the Northern Pacific Company is to absorb the Wisconsin Central system.

A freight train was run last month from New York to Tacoma, Wash. Ter., without being uncoupled. The entire train was loaded with dry goods. It passed over the Erie system to Chicago, thence to St. Paul by the Chicago, St. Paul & Kansas City, and the remainder of the journey of 3,500 miles by the Northern Pacific.

The official report of the Kansas Board of Railroad Commissioners for the year ended Dec. 1 shows that, compared with the population, Kansas is the best equipped with railroads of any State in the Union, and, although the report does not say so, it has the most fault to find with the railroads that have brought it prosperity.

We have learned from Mr. W. R. Billings, treasurer of the Taunton Locomotive Manufacturing Company, that this long-established locomotive building concern has recently come under new management, and that the intention is to improve the system of manufacture, so that they can compete successfully with other first-class makers.

The Grand Trunk Railway Company are removing all the machinery belonging to the repair shops at Hamilton to the new shops recently erected at Stratford. The workmen are also to be transferred to the new mechanical headquarters. It is expected that the whole work of removal will be finished by the end of January. Mr. J. Davis Barnett is in charge of the shops at Stratford.

Mr. E. P. Mason, vice-president of the Rhode Island Locomotive Works, informs us that they are turning out twenty locomotives a month. They have just completed three locomotives for the Western Railway of Alabama, and are now working on an order of fifteen for the Chicago, Burlington & Quincy. Among the engines turned out lately were five heavy freight engines for the Louisville, New Albany & Chicago.

The transfer boat "Maryland," of the New York, New Haven & Hartford road, which was transferring a passenger train across the Harlem river from Jersey City to New York, December 7, caught fire and was consumed. The baggage car with all the baggage and one coach sank with the boat, but the two sleeping cars were run off on the dock, where they were burned. The passengers in the sleepers escaped in scanty attire.

The Kansas City Car and Wheel Company, which is a branch of the Missouri Car and Foundry Company, of St. Louis, is operating its works, which are located at Birmingham, ten miles from Kansas City. The grounds comprise a tract of 36 acres, and the foundry, which has a capacity for melting 200 tons per day, is 600×100 feet in dimensions. About 500 men are employed at present, and the company has contracts on hand for 1,000 cars.

The Muskegon Car Works have booked orders for the manufacture of 600 cars, the work to commence immediately. The works for the past few weeks have been running light, doing repairing and turning out a few cabooses. These orders include one for 500 cars received from the Chicago & Atlantic Railroad Company. Another order for 100 cars had been previously booked for an Ohio road, a total order for 600 cars to be built this winter. These new contracts will insure steady work for the greater part of the winter, and other orders are in view.

At the car shops of the Philadelphia, Wilmington & Baltimore, at Wilmington, Del., a very handsome car has been built for the use of the superintendent of the road. The car is finished in oak inside, and has all the conveniences and luxurious trappings that are usually put into such cars. Last year they built 24 new passenger cars in these shops, besides doing an extensive business in repairs of all kinds. They are now engaged building stock cars 34 feet long. The frames are of the Howe truss pattern. Nearly all work in these shops is paid for by piece work.

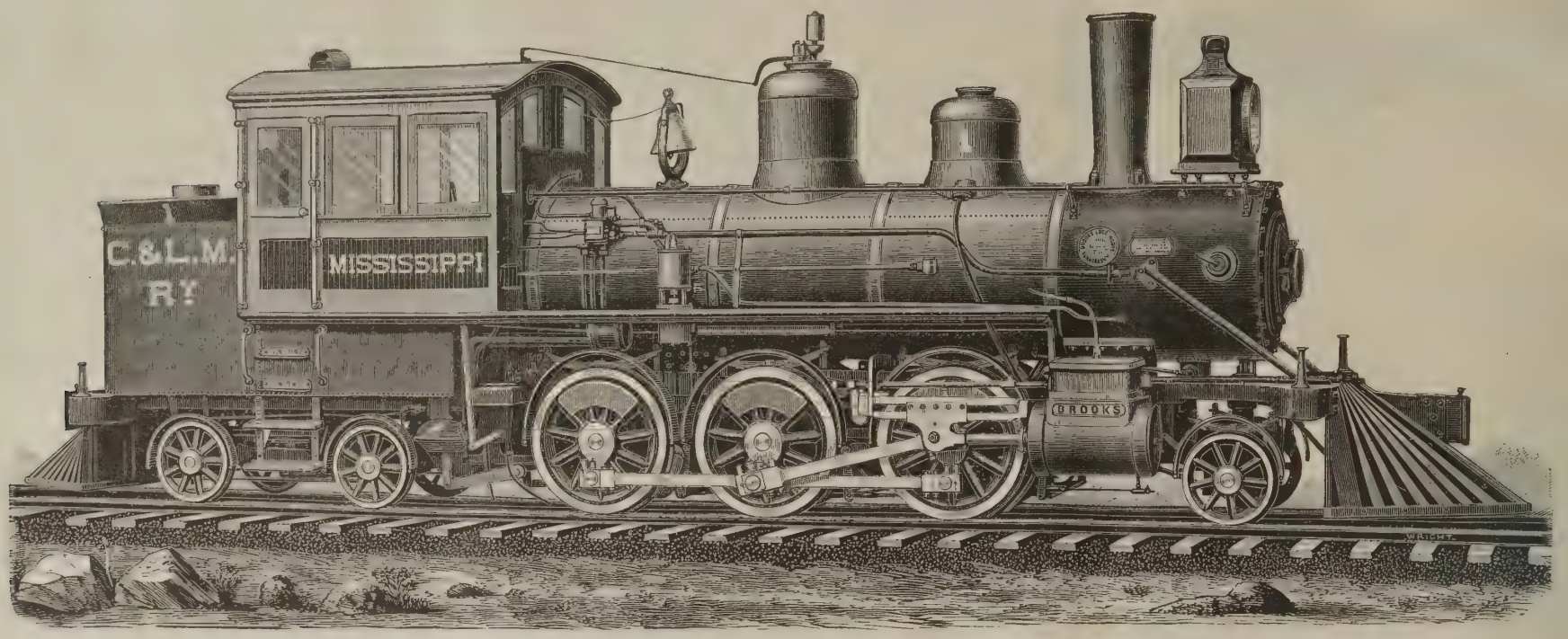
Bids have been received by the Pittsburgh, Cincinnati & St. Louis and the Chicago, St. Louis & Pittsburgh for building 2,000 freight cars, 1,000 box, 500 stock and 500 gondola cars, all to be equipped with the Janney coupler, and all but the gondola cars with the Westinghouse air brake. The box cars will have the Wagner doors. The Pennsylvania road proper has just placed an order for 2,500 box cars, to be equipped in the same manner. In future all freight cars of the Pennsylvania Co.'s lines will be equipped with the automatic couplers, M. C. B. type, and all stock and box cars with air brakes.

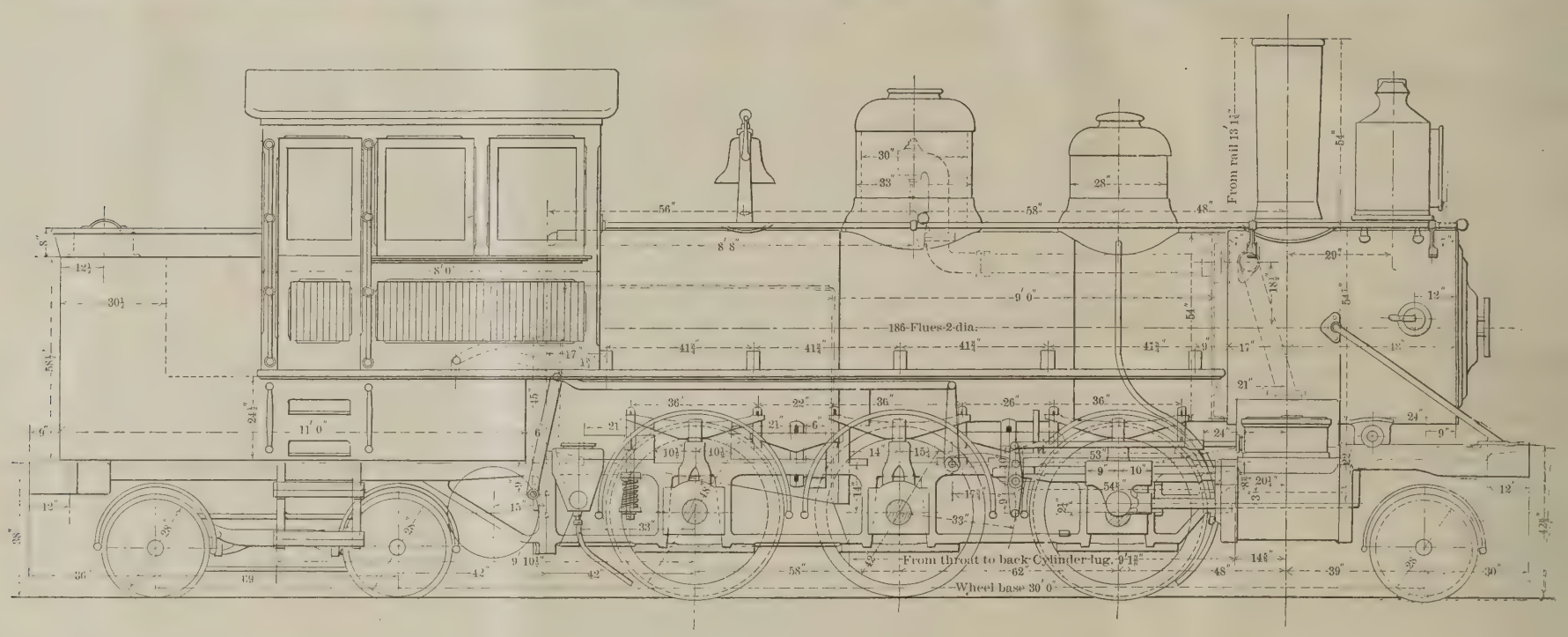
We are informed by an esteemed contemporary that two mammoth locomotives, the A. R. Darwin No. 1 and A. R. Darwin No. 2, built for the Atchison, Topeka & Santa Fe Railroad, began their trial trips last week on the route between Providence and Groton, Conn. (opposite New London). Each locomotive carries three boilers, (so says our e. c.) two engineers and two firemen. The engineers sit high up in a cab in front of two of the boilers, while the firemen are some 25 feet behind them and about four feet lower down. These ponderous engines are guaranteed, it is said, to draw 30 freight cars at the rate of 80 miles an hour.

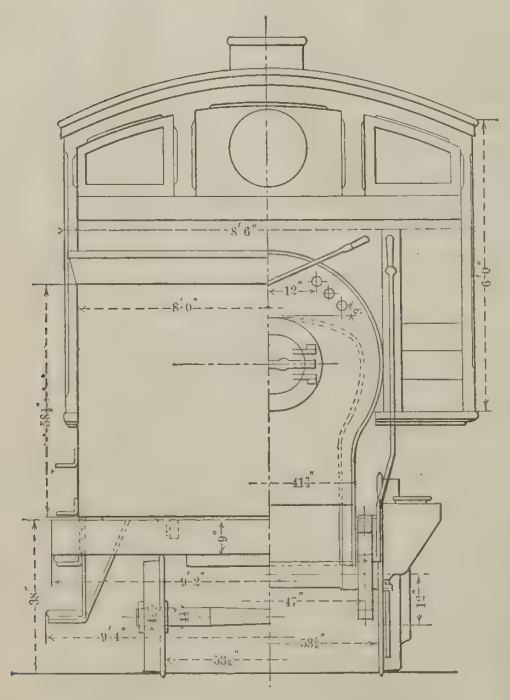
The National Association of Cattle Herders and Shippers, in their annual convention lately held in Chicago, passed the following resolution: Resolved, That we as cattle growers and shippers in national convention assembled, realizing the great suffering of cattle shipped and the loss to shippers by bruised and injured meat, caused by shocks in cars while in transit, believe it is opportune and even a duty to say to the great transportation companies, that we are inclined to give our patronage to such companies who so equip their stock cars with such brakes and close couplers as will prevent suffering to stock and loss to shippers.

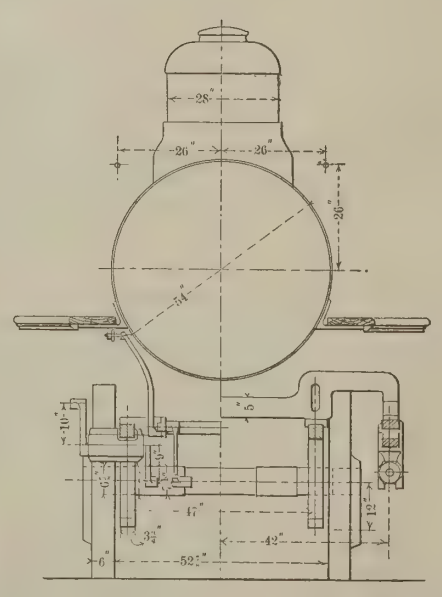
The output of the Baldwin Locomotive Works for the year 1888 reached a total of 736 locomotives, a greater number than the company has ever before built in one year. The per centage of heavy engines built was also materially increased. Of this total, 188 were of the American type and other eight-wheeled locomotives; 277 of mogul and other ten-wheel engines, and 269 consolidation. The contracts have included 50 locomotives for the Pennsylvania, 60 for the Philadelphia & Reading, 5 for a Brazilian road and 30 for a road in Argentine Republic, Among the orders completed or now in progress are locomotives for the Pennsylvania, the Denver & Rio Grande, the Chicago, Burlington & Quincy, the Northern Pacific, the Lehigh Valley, the New York, Lake Erie & Western, the Western New York & Pennsylvania and many other roads.

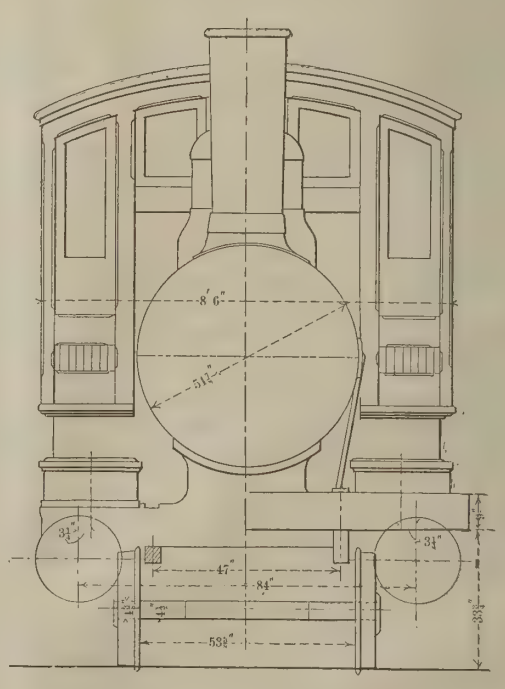
The Pennsylvania Railway system is said to have added 13,000 cars to its rolling stock equipment this year, and yet has an insufficiency for its traffic. The lack of cars on nearly all the railroads has been specially noticed for months past. There has lately been a revival of demand for car factory lumber, which indicates that the companies have been forced to increase their supply. The fact is that the railroad mileage of the country is now so enormously extensive, that the mere resupply of worn out stock necessitates constant work in the shops. The time will never again come that there can be a long continued dullness in car building. While wood shall be the material employed in such construction, a large portion of the saw mill product must go into rolling stock. This branch of demand must hereafter cut an increasingly large figure in lumber trade.—*Northwestern Lumberman.*











BROOKS' DOUBLE ENDED LOCOMOTIVE.

The above engravings illustrate a very handsome form of bituminous coal burning, heavy, double-ended locomotive, recently built at the Brooks Locomotive Works, Dunkirk, N. Y., and intended for handling heavy suburban passenger traffic or any other kind of heavy train service, where it is important to have an engine that will run safely in either direction without turning. The cylinders are 16 × 24 inches, and the driving wheels 48 inches diameter outside of tires. The weight on the wheels is 11,500 pounds on forward truck, 69,000 pounds on the three pairs of drivers, and 31,500 pounds on the back truck, which is a very good distribution of the 112,000 pounds weight. With 140 pounds to the square inch of boiler pressure, the engine exerts a tractive force a little over 15,000 pounds, and the coefficient of adhesion is about 4.5, as figured by the railway master mechanics' formula. The rigid wheel base is 10 feet, and the total 30 feet.

The boiler is of the straight type, 54 inches diameter at the smallest ring, with a dome, 30 × 27 inches, placed in the middle of the waist. Boiler and fire-box are of steel throughout. The boiler shell is $\frac{7}{16}$ inch thick, and the throat sheet is $\frac{9}{16}$ inch thick, to compensate for thinning in flanging. The cylindrical courses are made of one sheet each, with the longitudinal seams placed above the water line. The longitudinal and waist connection seams at junction of waist with fire-box are double riveted. All plates are planed at the edges and caulked with a round pointed tool. The rivets are $\frac{1}{16}$ inch diameter, placed 2¼ inches apart, in single riveted seams, and 2½ inches apart in the seams that are double riveted. There are 186 flues 2 inches diameter and 9 feet long. The outside crown and sides of the fire-box are made of a single sheet. The fire-box is 77 inches long, 34 inches wide at the grates and 47 inches wide at the crown sheet. The inside sheets are $\frac{5}{16}$ inch thick, except the tube sheets, which are ½ inch thick. At the back and sides there is a water space of 3 inches, and in front the space is 4 inches wide. The stay bolts are of double refined iron ⅞ inch diameter, screwed and riveted over sheets at both ends. Iron radial stay bolts of the same quality are used for supporting the crown sheet.

The engine has an extension smoke-box and open, tapered stack. Laird guides are used in combination with cast-steel cross-heads and composition bearings. The valve motion is the ordinary shifting link, eccentric rod jaws, link blocks and pins being made of case-hardened iron. The furnishings of the engine are all of the most approved type.

Capacity and Strength of Cars.

There is no structure of which we have any knowledge that has as great a variety of strain to withstand as the framework of a freight car. Very little is understood as to what is needed for service. It is common to see recently constructed cars designed for the same service by different roads with the same general dimensions and the same stencilled capacity, with the variation of thousands of pounds of weight of empty car, the greater proportion of the excess being in the framework.

Is it not practicable to design by scientific calculation what will prove to be a structure of given dimensions and weight, that will withstand the strains due to buffing, pulling, centrifugal force, gravity and shifting of the load, changes of temperature and atmospheric conditions, together with the natural decay for a reasonable period of its existence?

Assuming that you agree with me that we need some other material than wood for this, we look to iron or steel naturally as a substitute, and I would ask another question. Is the tubular an acceptable form in which with a given material to meet the requirements of freight car construction, or is the trussed frame made with iron tubes as a foundation factor capable of filling the requirements we have given as the demands of the hour, lightness, simplicity, with great strength and durability; and is it by reason of its material capable of keeping pace with the other branches of railroad operation?

We stand ready to prove by the testimony of the specifications from which the cars are built that the tubular car of to-day is lighter in its framework for given length and capacity than any successful freight car now in practical operation. Again, we carry the load on the framework of the car and do not depend upon the superstructure to aid in doing this. You will readily understand this fully when you know that the same frame is used and is being daily loaded to its capacity of 60,000 lbs. and over on a number of our flat or platform cars that we have in the high-sided gondolas. Can this be done with wooden cars? Is it not a fact that more and larger sills are put into flats than any other class of cars of equal length? The box or upper work not being called upon to carry any of the strains due to the gravity of its lading, you will readily see where our claim for lightness has another point in its favor.

Simplicity of construction is a matter that I know no persons more capable of deciding for us than the car-builders who have built 3,000 of these cars. We have their unsolicited testimonials, copies of which are at your disposal, to the effect that another thing very much in favor of this kind of car is the ease with which it may be erected. It requires less machine work and a much less skilled class of workmen than any other car we have built in our experience of over 20 years. We could turn out over 50 per cent. more of these cars with the same labor than of any similar car of the wooden pattern.—*G. W. Ettenger, at Western Railway Club.*

Construction of Freight Car Trucks.

1. What proportion of the new freight cars being annually built and of the old cars repaired in the United States are supplied with iron trucks and what proportion with wooden trucks?

2. What is considered the average life of the wooden truck? also of the iron?

3. Which do you consider the more desirable, iron or wooden trucks?

4. What is the cost of each kind?

The above questions were sent out by the editor of the *Railway Age* to leading car-builders, and the following were the answers received:

From Mr. H. L. Preston, master car-builder Chicago, St. Paul, Minneapolis & Omaha Railway, Hudson, Wis.:

"1. I am unable to obtain data from which to answer this question.

"2. What is considered the average life of the wooden truck, also of the iron? I assume the distinction placed here between the iron and wooden truck to be that the iron truck is constructed with iron or steel transoms and brake beams, and the wooden truck with wood transoms and brake beams, as aside from the transoms and brake beams I do not presume there are any freight-car trucks being rebuilt by any important railway in the United States of wood. The old wooden side or wheel piece freight car truck is, so far as my observation goes, about extinct. The wooden bolster is yet retained in most of the iron swing motion trucks.

"The cost (in round figures) of the iron truck, which includes all of the brake fixtures attached to it, with M. C. B. standard axles for 40,000 pounds capacity, cars and wheels weighing 600 pounds each, is about $145 per truck, or $290 per car, and the cost of a wooden truck, with the specifications for wheels and axles same as in the iron truck, is about $120 per truck, or $240 per car. These trucks being substantially of the same construction, aside from the transoms, it would be fair to presume that the amount of service obtainable from the two classes of construction would not vary greatly, aside from the probability of having to renew the wooden transoms once or twice during the life of the balance of the material.

"I doubt if there has been sufficient experience with the iron truck to place a correct average upon its service; leaving the wheels and axles out of the question I should judge that with proper attention in the matter of repairs it would be in the main a pretty fair truck after a service of twenty years.

"I am not able to give a decisive answer as to which is the most desirable of the two trucks, as we shall have to take into consideration the first cost and comparative liability to need repairs, and sufficient time has not elapsed to determine it; from my own observations so far I am inclined to favor the iron truck as the most desirable."

From Mr. Robert Miller, assistant general superintendent Michigan Central, Detroit, Mich.:

"(1) All new freight cars built for the Michigan Central and about 25 per cent. of the rebuilt cars are equipped with the iron trucks.

"(2) Our experience with the wooden truck is that they require constant replacements of the timber parts. I have never seen a wooden truck over ten years old that was not racked to pieces and unfit for service. This after receiving more or less attention from light repair stations on the line. An iron truck will outlive the car body by many years. This company has been building iron trucks for about thirteen years, and in scrapping cars that have outlived their usefulness, we find most of the iron trucks ten to thirteen years old to be good for ten years more with light repairs.

"(3) Iron.

"(4) I presume that the price adopted by the Master Car-Builders' Association is a fair average—$200 wood, $250 iron. Our standard 20-ton swing motion iron trucks cost us $245 per car and the 30-ton trucks $270 per car."

From Mr. John Kirby, General Master Car-Builder Lake Shore & Michigan Southern Railway, Cleveland, O.:

"First question I cannot answer, but think that very few freight cars are being built this day having wood trucks under them; the old trucks probably are repaired. I should say that fully 90 per cent. of the freight cars of this country have iron trucks under them.

"(2) Fifteen years wood, twenty years iron.

"(3) I consider iron the most desirable.

"(4) A good iron diamond form of iron truck will cost to-day $105. Cannot say much about the wood truck, not having built wood trucks for freight cars in twenty years. Freight I suppose is what you refer to."

From Mr. Clem Hackney, Superintendent of Machinery Union Pacific, Omaha, Neb.:

"In answer to queries contained in yours of the 3d inst., would say, 1st, I consider the average life of the freight trucks 12 to 14 years. 2. I consider the freight truck with wooden transoms and bolsters most preferable at the present time. My reason for this preference is the fact that where there is so much interchange of freight cars, I always find that when our freight cars with said parts made of wood have to be repaired on foreign roads said repairs are made at once, but where these parts are made of iron sometimes a long delay is caused by these roads laying the car up and calling for the iron parts to repair car with. I have every reason to believe that in the near future an iron freight truck will be adopted and will come into general use. We use an iron tender truck and find that it gives good satisfaction. 3. All freight car trucks which we are having built at present have the wooden transoms and bolster."

From Mr. G. W. Tilton, superintendent motive power and machinery, Chicago & Northwestern Railway Company, Chicago:

"Replying to the question pertaining to freight cars will say in answer to your first question in regard to the new freight equipment being built or rebuilt in the United States annually I have no data at hand that could show conclusively the percentage of the same equipped with wooden or iron trucks. I am of the opinion that at least 50 per cent. and perhaps more are being equipped with iron trucks. In your second question you ask what is the average life of the wooden truck? While we have no records that will show this conclusively, I think in twelve years the cost of maintaining the trucks will equal the cost of new. To your third question I consider the iron truck preferable. To your fourth question the wooden trucks cost about $200 per car and the iron trucks about $250."

From Mr. J. C. Barber, master car-builder Northern Pacific Railroad, St. Paul, Minn.

"Referring to your question No. 1, I am not prepared to reply to this, except as relates to our own line. We are not using any iron trucks under either our old or new freight equipment. We use a plain swing-beam truck with iron arch-bars, double column bolts, wood transoms and double trussed swing bolster, capacity 25 tons.

"Question No. 2.—The life of a common double bolster truck with cast columns and single column bolts, or what is known as the 'rigid truck,' is about seven years, and there are several patterns of swing-bolster truck that are no better than the rigid truck and last no longer. A good swing-beam truck, similar to our (N. P.) pattern will last from twelve to fifteen years. I do not call to mind any line using iron trucks, and have no experience with them. There are several lines which claim to use an iron truck, but they do not. The C., B. & Q. and several other lines use a so-called iron truck, but the swing bolsters are of wood, or wood and iron combination. The brake beams are also of wood and their capacity no greater than many patterns of wood swing-beam trucks. Therefore I do not consider the life of a wood and iron combined truck to be any longer than that of a first-class wood swing beam truck.

"Question No. 3.—I consider an all iron truck, throughout, the most desirable and think it could be made to last fully twenty years, with but very slight renewals of one or two small parts.

"Question No. 4.—I have not had occasion to build both classes of trucks, but basing cost on information from builders, etc., I state cost as follows: One set (two trucks) of common double bolster, or rigid trucks, $150 to $160. First-class wood swing beam truck, $210; common wood swing beam truck, $190. First-class iron channel-bar trucks, with iron and wood combined swing-beam and iron brake beams, per set, $250 to $260."

Mr. F. D. Adams, general master car-builder, Boston & Albany Railway, Allston, Mass.:

"1. I am not an encyclopedia of mechanical knowledge. Ours are all iron.

"2. I do not know. We have them in use for over 30 years and they appear as good as ever.

"3. Iron of course.

"4. The cost varies according to the circumstances or plan. Ours cost about $300 per pair."

A similar letter was addressed to most of the car works of the country asking information in regard to experience and observation as to the proportion of iron and wooden trucks used in building new freight cars and repairing old cars; also their comparative desirability and cost. The following answers were received:

From J. C. Fortune, superintendent of the United States Rolling Stock Company, Hegewisch, Ill.:

"During the last three years just about one-half of the freight cars we have built have had iron trucks. The difference in the cost between iron trucks and wooden trucks depends entirely upon the specification, but the nearest approach to a difference for the same truck with or without channels would be about $25 per car."

From the Peninsular Car Company, Detroit, Mich.:

"Your understanding that iron trucks are daily growing in favor and are rapidly being substituted for those of wood is correct. There is no question in our minds of the advantage of a properly designed iron truck over a wooden truck. We have thus far this year placed the truck recommended by the M. C. B. committee two years ago under 2,000 cars.

"You will have to excuse us from giving you the cost of iron trucks, as this would be talking 'shop' to a greater extent than we deem desirable."

From the Michigan Car Co., Detroit, Mich.:

"At least three-fourths of all the cars we have built during the last two years have been equipped with iron trucks."

"From Mr. H. H. Sessions, Manager Pullman Car Works, Pullman, Ill.:

"Calculating the cars we have built the past year, we have constructed about 20 per cent. of iron trucks and 80 per cent. of wood. As regards their comparative merits, that it would depend entirely upon the plan of the wooden truck as to whether or not it was inferior, equal, or superior to the iron truck. We have built some wooden trucks which I consider superior to the iron."

From the South Baltimore Car Works, Baltimore, Md.:

"We have recently completed 1,000 cars with wooden trucks and are now at work upon a lot of 500 with the iron trucks. There are so many factors entering into the costs of the respective trucks that we prefer not to write on this subject, and, being builders, we are naturally in a position where we cannot express a preference for the one over the other."

The Wason Manufacturing Company, Springfield, Mass., write:

"We have never had a call for freight cars with iron trucks.'

From Mr. George G. Boyer, Superintendent Harrisburg Car Manufacturing Company, Harrisburg, Pa.:

"We have built no wooden trucks since about 1875. The last built were for New York Central & Hudson River Railroad Company, who adopted iron trucks about that date. The Pennsylvania Railroad has been using iron trucks for many years. In fact we know of no wooden trucks being placed under freight cars for the past ten years. As to relative cost, can only say that we have no data to name by, the iron trucks having been greatly increased in capacity since wooden trucks were constructed. The difference in cost of trucks of same capacity would not be much in favor of wooden trucks, whilst the desirability would greatly favor the iron trucks in our judgment."

The Ensign Manufacturing Company, Huntington, W. Va., write:

"So far as our observations go, the iron truck is being less used than formerly. The comparative cost is from $20 to $25 per car more than for the wooden truck.

Messrs. Pennock Bros., Minerva, O., write:

"If by 'wooden trucks' you mean the old frame truck as for merly used by the 'Harlem' and 'Jersey Central,' we have not had a call for them in five years. Ninety-five per cent. of cars we have built in the last two years have been equipped with the diamond truck with rigid bolster. We now have contracts with three railways, aggregating 1,825 cars, all of which call for diamond trucks with wood bolsters and spring planks. The iron channel bar truck costs from 10 to 15 per cent. more than the above. We believe the diamond truck will carry more tons of freight, for an equal expenditure in first cost, repairs and interest than any other now in regular use."

A very simple form of coupler for connecting the heating pipes between cars has been invented by Mr. R. H. Soule, general agent of the Union Switch and Signal Company. Two steam-tight faces come together, making a straight passage through the pipes, and the coupling is done by a sleeve guided by screw threads. The coupler will be used in connection with the Standard Car Heating and Lighting Company's system of car heating.

Early Coal Burning Locomotives.

In the course of a conversation with Mr. William Buchanan, superintendent of motive power of the New York Central Railroad, we heard a great many interesting facts about the various forms of fire-boxes that have been tried in locomotives. Mr. Buchanan, who is the inventor of one of the most successful soft coal burning fire-boxes ever applied to a locomotive, is particularly well acquainted with all the experiments made in this country and in Europe by railroad men and other inventors, who have labored to produce a furnace perfectly adapted for the economical combustion of bituminous coal. The old Hudson River Railroad Company, with which Mr. Buchanan was connected, applied to their locomotives many of the so-called improvements designed for the purpose of burning soft coal properly. Among other devices, the combustion chamber was tried in numerous forms. It was tried from 1 foot to 5 feet long. Large flues and flues as small as 1½ inches were tried with it. Brick arches were applied in various forms to protect the chamber, and various methods were adopted to mix air with the gases in the combustion chamber, and nothing that skill directed by zealous intelligence could do to make the device a success was spared. But it all availed nothing. It was found that the plain fire-box did as well as the fire-box with a combustion chamber, and most of the engines did better when the combustion chamber was abolished and flues put in place of it.

Mr. Buchanan applied a brick arch to one of the engines as early as 1857; but he used common fire brick and the arch did not stand well.

New England Railroad Club.

RAILROAD SHOPS.

At the December meeting of the New England Railroad Club Mr. J. W. Marden, Fitchburg Railroad, read a paper on the above subject. He expressed the belief that railroad companies could build their cars and locomotives as cheaply as they could buy them, if they had the proper facilities for doing the work. He had considered all sorts of plans for car repair shops, and concluded that the best form was an oblong building with transfer table for moving the cars. Considered it important to have plenty of light in the shops. Continuing he said:

In the arrangement of tools, especially in the wood-working shop, I think a building that is perhaps 50 to 60 feet wide or more, and sufficiently long to do the work, is better than a square building. I would make it fully as long as required for the work, and then I would arrange the wood-working machinery so that the lumber as it came into one end would pass continuously down through the shop to the different machines until it was ready to go into the car, and from there pass by the shortest route to the place where it is to be used in the car. The machinery for the lighter work could be arranged as thought best, but I would have the machines that are intended to get out the frame part of the car so arranged that there would be no backward travel for the lumber. In the matter of machinery, I think that a road could almost afford to throw away its machines once in five or six years and buy new machinery, on account of the improvements made in it. I think it is a mistaken idea that we must run a machine until it has run out before we can buy a new one, especially if there are new machines that will do twice or three times as much work as the old ones.

I don't know as I can do better than to call your attention to the plan of the shops that our road is building now at East Fitchburg, as it will show you my idea more clearly of what I think we ought to have for shops on the Fitchburg road, on the plot of land that we have assigned to that purpose, a level plot on the side of our main tracks running towards Fitchburg. The shops are designed to be four in number, that is, the working and repair shop, with a transfer table between the freight repair and freight erection shop, and one between the passenger and paint shop, with a suitable number of tracks in each shop; in this instance we have 24, by which we can either put the cars into the shop or on to the transfer table. The lumber will come in at one end of the shop, and will pass on from one machine to another, and when it goes out will be ready for the erection of freight cars, and will be taken to the various shops where it is to be set up. There will be a covered passageway from the second story of this shop into the passenger erection shop. At the end we have our dryhouses. Mr. Marden further explained the plan, pointing out the location of the upholstery and furniture room, the arrangement of the transfer tables, etc.

We have carefully studied the subject of flooring in connection with our shops, and have finally concluded that a concrete floor will be, perhaps, best for the paint shop, and all other shops except the blacksmith's, and for that plank for the under floor, either yellow pine or spruce, with about 1⅛ inch of yellow pine floor on top of that. Our idea is that if the top board should wear a half or three-eighths of an inch, or to such a depth as would require its removal, it would be easier to remove the thin flooring than to take up the planking, and much cheaper for the company.

President Lauder wished to hear the form of building for the machinery freely discussed. His preference was for a wide building with one line of shafting through it and the machinery placed crosswise of the shop. Thought if this were done the lumber could start at one end and pass back and forth through the machines much more conveniently than it could if the tools were placed lengthwise.

Mr. J. D. Adam, Boston & Albany, believed that the surroundings regulated to some extent the best way of placing tools. He preferred placing the machinery crosswise because they could be driven by one line of shafting. The objection might be raised to this plan that it obstructed the passages, but more moving of cars was rendered necessary by having the tracks run lengthwise, especially in a long, narrow shop. The round-house had many advantages as a repair shop, but he did not favor it, owing to the trouble experienced with the turn-table in winter, when the pit was apt to get filled with snow. Thought providing for the free admission of light into a shop a very important matter. Favored a one-story building with large windows all round, and good skylights in the roof. Believed in using good modern machinery, and thought it would pay railroad companies to scrap machinery that had been in use 10 or 15 years. The use of old machinery by railroad shops prevents them from competing in prices with the work done in contract shops. Expressed the belief that if railroad shops built their own cars, they would last from one-half to one-third longer than contract cars with less expense for repairs.

President Lauder found that a good many mechanics spoke favorably of the round-house style of freight car repair shop. They have plans under consideration for new shops, and the intention is to make the paint shop and passenger and freight car repair shops similar to those described by Mr. Marden. Thought the arrangement of tools and machinery of great importance. The handling of lumber is a large item in the expense of building freight cars, and the tools should be so arranged that this handling would be reduced to a minimum.

Mr. Adams spoke of the mistakes made in putting up shafting that was too small. He advocated heavy shafting and long bearings.

Mr. A. Griggs, Providence & Worcester, exhibited plans of his car shops, which President Lauder declared to be the best planned shops in New England. The shafting of the wood working machinery runs crosswise; a track runs from the repair shop through the wood-working machine shop to the rear of the back yard; there are five tracks back of the shop, so that the lumber could be taken away at any point and readily brought to the planer, the saw, and the other machines.

President Lauder: The last time I was in Pullman they said the great mistake in their shops was in not having the line of shafting underneath the floor and a belt up through for their machinery.

Mr. Adams: That has advantages and disadvantages. I think I should differ on that point. I don't think I should put my shafting under a wood mill. Mr. Whitney and Mr. Griggs rather favored shafting under the floor.

Mr. Marden: I can readily see that placing the belting under the floor of a car shop would depend much on the location as well as the plan of the building. If you have a cellar under your car shop or machine shop it must be well drained and dry. We have at one point in our road a mill with a cellar under it, and about two or three times a year we are likely to get a flood that will wet our belts all over, and it is some little time after that before we are in good working order again.

If the shops on our road are not large enough they will not blame any one but me. After I had laid out the plan for erecting the shop 450 feet long the engineer said he thought we had better make them 480. So we have not been hampered in that way; the officers of the road insist upon having the shops large enough to take care of the work in the future.

Mr. Coleman: In handling timber in car shops the belts interfere with swinging round a long piece, and an underneath arrangement of the shafting seems to me desirable. At the Corliss Works, in Providence, their shafting is all underneath; it is perfectly accessible, so that a man can oil it easily. That is considered a model shop in every respect for the purpose for which it was designed. Another advantage in putting it below is that the basement is the most solid and strongest part of the building. I think it a necessity that these large shops should be lighted in the centre; but I am told that if the skylight is inclined, although it may afford a better light, it will always be leaking.

Mr. H. A. Whitney, Intercolonial: We have inclined skylights in our shops which were put on 15 or 16 years ago. and they make no trouble by leaking, although we had some put on within a year or two that did leak. If they are properly put on there is no trouble in getting them tight.

Professor Lanza: We have had some sad experience in that matter. We have had our shops lighted with inclined skylights and they have caused trouble by leakage.

Mr. Griggs: Our machine shops and car shops were heated by overhead heat, to which I objected from the start. With 60 or 70 lbs. of steam on, the shop was not warmed so that the men could take their coats off. At the same time it warped up the three-inch plank on the roof and split the slates off, and last year we took it down as a failure. The heat did not come down into the mill, it all went to the top, and I don't want any more overhead heating.

The President: I remember we employed an architect to design and construct a fancy railroad station, and when it was finished a few of us went down to inspect it. The radiators were about 8 ft. up on the wall. After experimenting for a while, the result was we had to take them down and put them on the floor. In opposition to that, I was discussing our new shops with Mr. Borden, one of our directors, a millman at Fall River, who was as enthusiastic and positive that the overhead system of heating was the right thing as he could be.

Mr. Marden: Mr. Whitney stated that he had good success in lighting his shops with inclined skylights. I don't understand the method of keeping them tight.

Mr. Whitney: The glass is put in in the ordinary way, made to lap; the sashes are good and firm, the glass is good, and carefully laid, and they have never given us any trouble, and I think it is better to have a skylight fitted at an angle than otherwise.

Mr. Coleman: I saw a paper mill made from a section of the Exhibition building in Brussels, that had a roof of shingles of glass, the whole roof was glass, and on a bright sunny day it was an exceedingly light shop, and a very warm one; it was as light inside as outside the building.

The president announced that the subject of discussion for the next meeting would be, "The Metric System of Weights and Measures as applied to Railway Service," and stated that the subject would be opened by Mr. George Richards.

New York Railroad Club.

CAR WHEELS.

At the December meeting of the New York Railroad Club there was an unusually good attendance of railroad men and others; Mr. R. C. Blackall occupied the chair.

Mr. J. N. Barr, superintendent of motive power of the Chicago, Milwaukee & St. Paul, read a paper on car wheels. After apologizing for appearing as a public exponent of car wheels, and mentioning his intimate acquaintance for fifteen years with the manufacture and service of car wheels, the author said that railroad officers responsible for the safety of trains are often perplexed as the following questions arise:

1st. Are the wheels strong enough to afford reasonable assurance against breakage?

2d. Could we with safety buy a cheaper wheel or should we buy a more expensive one?

3d. Are the wheels of such a character as to give good mileage results, and might not improvements be made?

4th. Are the wheels in service so treated as to secure the best and most economical results?

The writer was inclined to believe that, with an adequate conception of what constitutes a good wheel, with proper inspection and tests, and adequate wheel records, the above questions may always be definitely answered.

In order to present the matter in a systematic form, it will be taken up in the following order:

1. Description of a perfect wheel.
2. Variations from a perfect wheel as found in practice.
3. Causes of such variation.
4. Inspection and tests to which wheels should be subjected.
5. How wheels fail in service.
6. Wheel records and what they should teach.
7. Mileage results.

A perfect wheel should answer to the following description:

1. The tread should be perfectly cylindrical.
2. The tread and inside of flange should be perfectly smooth and free from any defect that would impair the integrity and homogeneousness of the metal forming the parts subject to abrasion, and should conform in outline to chill.
3. The body of the wheel should be sound and smooth, and free from any of the defects usually seen in the castings.
4. The wheel when broken should show a shell of white iron extending inward from the parts subject to abrasion, not less than three-eighths of an inch, nor more than three-fourths of an inch, and this shell should not vary in thickness in the same wheel.
5. There should not be a distinct line of demarcation between the white and gray iron, neither should the gradation from white to gray be very undecided.
6. The gray iron forming the body of the wheel should be of medium grain, dark color, a ragged fracture, free from imperfections or white iron.

In practice wheels never realize the above description, their perfection being more or less impaired by the following defects:

1. Chill cracks. 2. Rough treads. 3. Slag in tread. 4. Sweat and depression at throat. 5. Irregular depth of white iron. 6. Too great or too small depth of white iron. 7. Lack of roundness.

There are other defects which are also common to general castings, but they will not be discussed here.

The mold in which car wheels are cast consists in general of an iron ring shaped on the inside to form the tread and inside of the flange. The remaining part of the mold is composed of sand as for ordinary castings. The iron ring, or chill as it is called, causes the molten metal to cool rapidly, forming white iron, and it is on the depth, hardness and perfection of this shell of white iron that the durability of the wheel depends. In order to fully appreciate the character and importance of the defects mentioned above, a definite idea should be obtained of what takes place as a car wheel mold is filled with molten metal.

The operation of pouring a wheel and the behavior of the molten metal and the chill may be described as follows: The molten metal enters at the hub, spreads over the sand forming the bottom part of the mold, thence through the depressions in the sand which form the brackets into the flange. When the molten metal rises to a level with the point of the flange it first comes in contact with the chill. It then gradually rises, covering the inside of the flange, the throat and finally the tread, until the mold is filled. The length of time consumed in pouring varies from twenty to thirty seconds, sometimes falling below the minimum mentioned, and sometimes exceeding the maximum. In general an interval from ten to fifteen seconds occurs between the time the molten metal first touches the chill and the time the chill is entirely covered. Numerous experiments have been made which show that when molten metal is poured against a chill, a contact of ten seconds is sufficient to form a solid shell nearly one-fourth of an inch in thickness. We have then in the ordinary proces of pouring a wheel, at the instant the mold is filled, the following condition of things: A shell of metal nearly one-fourth of an inch in thickness has been formed against the flange portion of the chill, and this gradually decreases until at the top of the chill the shell is just beginning to form. This shell as soon as it forms starts to shrink. The chill is rapidly abstracting heat from the molten metal and starts to expand. The body of the wheel is composed of molten metal which exerts an outward pressure against the tender rod hot shell of metal which has solidified against the chill and resists its contraction. The shell of metal formed against the chill gradually thickens and contracts, the chill itself expands and the body of the wheel solidifies. In the operation described above it is more than likely that before the shell formed against the chill has reached an average thickness of one-quarter inch, entire separation has taken place between the chill and the shell, and the hardening influence of the chill is no longer felt. The above described operation should be carefully borne in mind, as on it depends either directly or indirectly nearly all the defects peculiar to wheels, which will now be more fully discussed.

Mr. Barr then proceeded to discuss the various surface defects usually found in car wheels, such as chill cracks, rough tread, slag in treads, sweat, etc., and attributed most of the defects to slowness of pouring, entailed by the efforts to prevent chill cracking, which is liable to result from fast pouring when a common chill is employed.

The author of the paper then described his method of casting wheels in a contracting chill. The chill consists of 96 segments cast radial with a common center and attached to an outside cylindrical ring. This ring is hollow and permits the passage of steam or water. Before the metal is poured steam is passed through this ring, which expands it, drawing out the segments away from the center of the circle. At the moment of pouring the steam is shut off and a stream of cold water is forced through the ring, which makes it contract and force the segments inward, so that they follow the cooling metal and keep it in contact with the chill till solidification is complete. This enables them to pour the metal for each wheel in from ten to fifteen seconds, without any fear of chill cracking. More than that, it greatly deepens and improves the chill, and the common surface defects of cast-iron wheels are prevented. Figures were given showing that on the Chicago, Milwaukee & St. Paul the mileage of car wheels had been greatly increased since wheels made in the contracting chill were introduced.

As to inspection and tests he continued: This matter is becoming of much greater importance than formerly. The proposed 60,000-lb. car with its greater weight of body as well as load, the increasing speed of freight trains, the more severe service to which wheels are exposed in all respects is beginning to render systematic tests and inspection a matter of necessity. As to the tests and inspection to which a wheel shall be subjected before it is accepted by a railroad, this matter is very ably handled in the Specifications and Tests adopted by the Master Mechanics' Association in their convention held in the year of 1888. If the requirements of these specifications are fully met, damage from breakage of wheels would be of extremely rare occurrence, and the average mileage of wheels would be much greater than at present. The writer is inclined to think, however, that for 60,000-pound cars, the requirements as to strength should be increased. He has no data to enable him to speak with authority as to the Pennsylvania test. As to the other test of a 100-pound drop falling seven feet upon the plate close to the rim, a 550-pound wheel should require twenty-five blows, a 575-pound wheel should require thirty blows and a 600-pound wheel forty blows to break a piece out. The writer favors the second test because it is applied in such a way that the fracture produced is a near approach to what occurs in service, and any attempt to add material to enable wheels to resist this test, will result in rendering the wheels less liable to breakage in service, even if some of the metal so used be removed from the hub. On the contrary, the attempt to proportion the metal in a car wheel to resist a blow on the center of the hub, will produce a distribution of metal which is not so well adapted to resist the breaking strains to which a wheel is subjected in service.

Many other subjects connected with the manufacture and service of wheels were discussed. The various wheel-makers of the country were very well represented in the meeting, and the paper was read to a highly attentive and critical audience.

Mr. W. T. Hildrup, Harrisburg Car Company, questioned the advantage of using a contracting chill, and thought with care and skill as good wheels could be produced by the ordinary process. Believed that mismating of wheels had a great deal to do with flange cutting.

Mr. Lobdell, of the Lobdell Car Wheel Company, Wilmington, Del., saw no difficulty in making car wheels by the old method, free from the defects pointed out in the paper. He had often measured wheels that had to be removed for flange cutting and found both of the same size. Believed that defects in the trucks did more to cause flange cutting than anything else.

Mr. W. E. Chamberlain said that the loading of cars had a great deal to do with the cutting of wheel flanges. Cars were often loaded to one side so that the weight rested on the side bearings and tended to make the truck run to one side. Oil cars seldom had flange worn wheels, and he gave this as an illustration of the injury done by loads being placed unevenly on cars.

Mr. Whitney, of A. Whitney & Sons, Wheel Makers, Philadelphia, indorsed every word that Mr. Barr had used in the paper, and at his motion a vote of thanks was passed to the author. He would not change ten words in the paper, and considered that the use of the contracting chill was a step in the direction of making perfect wheels. He was using contracting chills which greatly improved the character of the wheels produced. Wheels made in this way were nearly all perfectly round and free from the surface defects which did so much to shorten the life of ordinary cast-iron wheels. By actual tests he had found that their wheels cast in contracting chills came out nearer a perfect circle than steel-tired wheels were as they came from the lathe. Insisted that a stronger

wheel than that commonly made was needed for a 60,000-pound car, and believed that the contracting chill would provide for the making of one sufficiently strong.

Mr. Lobdell questioned the correctness of the theory that in a contracting chill the form moved to follow the contracting of the cooling metal.

Mr. Whitney said that when the cooling metal drew away from contact with the chill, part of the chill formed was drawn out by the molten metal. He held that metal in solidifying acted like water in the formation of ice and expanded, but contracted as it cooled.

Mr. C. T. Chapin, Rochester Car Wheel Works, testified to the improvement effected in their manufacture of wheels since they had adopted the Barr contracting chill.

Mr. F. D. Adams, Boston & Albany, said they were keeping a close record of wheel service, and they found that 98 per cent. of the wheels that broke failed shortly after coming off the descent of a long steep grade they have on the road. He found they fractured in the plate, half-way between the hub and tread.

Mr. Barr attributed the breakage referred to as being caused by heating of the wheels by long and hard application of the brakes. Understood that the same trouble was experienced on the Pennsylvania and Union Pacific and other roads having long grades.

Mr. John A. Hill, of the *Locomotive Engineer*, mentioned that on the Denver & Rio Grande, where he had been employed as an engineer, there was no trouble from broken wheels on the longest grades. All the cars are equipped with air brakes, and the brake shoes are never so hard applied to the wheels of one car as they are on trains that are controlled by a few hand brakes twisted up as hard as a brakeman can do it.

Secretary Smith quoted figures from correspondence he had with many companies which showed that the introduction of brakes to both trucks of cars was progressing very rapidly.

Mr. Hildrup said that the cast-iron wheel is to-day more perfected than any other part of a freight car.

The discussion was long continued, but nothing more of special importance was said.

Western Railway Club.

WATER CIRCULATION AND PURIFICATION.

At the December meeting of this club Mr. Herbert Hackney, Atchison, Topeka & Santa Fe, read a paper on the above-mentioned subject. He began by demonstrating the necessity for improving the circulation of water in locomotive boilers. In thinking over the advantages that would follow in locomotive operating from a constant circulation of the water in the boiler, he came to the conclusion that a combined circulator and water purifier was necessary. He invented and patented an arrangement to perform this desirable service.

The fundamental principle of the invention, he explained, is its circulating feature. Taking the water from the coldest and most stagnant part of the boiler, forcing it by expansion to rise to the hottest part, it most assuredly produces the much desired effect of thorough circulation. The second important characteristic of the device is its capability of taking the coldest water from the boiler, also the water which carries the most precipitate through pipes passing through the fire-box and into a large settling chamber in the upper part of the boiler. The pipes passing though the fire-box, being two inches in diameter and the settling chambers in the interior of the boiler being six, the circulation of the water in the fire-box pipes, which would be rapid enough to carry the particles of mud and lime through them without burning would be sufficiently slow in passing through the six-inch settling chambers to enable the sediment to fall to the bottom. On account of the inverted angle iron at the bottom of the chambers the impurities naturally fall into the valleys on each side of the angle iron, the edges of which being notched, and the surface cock being connected to the space underneath the angle iron, it is quite clear that by opening the surface cock all the mud and impurities lying in the valleys on each side would be forced through the notch in its edges, and expelled from the boiler with the least possible amount of hot water being blown out, and yet thoroughly cleanse the settling chambers.

This idea was for the purpose of economizing, as much as possible, the hot water in the boiler. On account of the circulating pipes in the fire-box taking the coldest water there in no danger of the water being filled with steam bubbles, as would be the case were the pipes to take the water from above the zone of combustion, hence, there is little danger of the pipes being burned out.

On March 15, 1888, we put an engine in service with two of the circulating pipes and two of the settling chambers and she is still in service, giving us no trouble whatever and running on water averaging 25 grains of scale-producing matter to the gallon. This, I think, clearly demonstrates that the pipes are not liable to give more than the ordinary amount of trouble.

The most remarkable feature of this device, however, in its workings, is the condition in which the fire-box sheets are found to be after an engine has run 5,000 miles without having steam taken off or the water changed. An engine having made this mileage was held in for a washout, the water allowed to flow gently out through the blow-off cock, and on taking the washout plugs out of the wagon top I discovered on the crown sheet what looked like a crumpled brown paper, wet; nothing seemed to be adhering to the crown sheet, but there seemed to be a loose buckled layer of scale. Upon introducing the hose into washout holes this was easily washed off, and upon examination the crown sheet which when leaving the shop had a scale of from $\frac{1}{32}$ inch to $\frac{1}{16}$ inch thick, was found to be, after making 5,000 miles without being washed out, absolutely free from scale, and no scale has since accumulated on the crown sheet, although this engine has run since April 28 on water averaging over 25 gr. of scale-producing matter to the gallon and the engine averaging over 4,000 miles between washouts.

As nothing is done to purify or change the feed water before entering the boiler, and in fact nothing is done to purify the water until it has lost its identity as feed water and become part of the boiler water itself, it certainly does go to show that these benefits are derived entirely from the rapid circulation of the water in the boiler which deposits on its way the impurities which it contained. It is this condition of things which causes me to think that when we properly understand the great value of a thorough circulation of the water of the boiler, many of the difficulties now troubling many master mechanics on account of bad water will be overcome.

The reason I assign for the cleaning of the crown sheet and keeping it clean is that by throwing the cold water from just above the mud ring its place is taken naturally by the next coldest water, which is that lying at the front end of the shell of the boiler, near the bottom, which, moving away from the front end of the boiler to take the place of the water just above the mud ring, enables the next colder water to fall into its place from the upper part of the front end of the boiler shell. This in turn makes room for the heated water from the fire-box to pass to the colder upper part of the front end of the boiler, and in this movement of the water lies the success of the device.

With this device an engine can leave the shop after receiving a general overhauling and go into service without changing the water with which the boiler was filled for testing and put in the most important service without experiencing any difficulty on account of foaming.

Mr. Hackney, in answer to questions, said that they get the best results from a circulator in the fire-box composed of four pipes. They used two pipes for small engines, and called that half capacity.

President Rhodes felt very much interested in the subject, for on some of their Western divisions washing out had to be done every trip or two. Was very much surprised to hear that coal mine water had been used successfully in engines equipped with Mr. Hackney's purifier. Last fall, he said, we had on our road a great deal of trouble from leaky flues on one of the divisions of the road, and it seemed to be unaccountable why our flues leaked so on one particular division. We investigated the matter as carefully as we could, and we thought there was some carelessness in the shop, that possibly our men were neglecting the flue work, but at last one of our master mechanics, in looking over the water on the division, found that a new coal mine had been opened, and that the water from this coal mine was being pumped and was flowing into the stream which supplied one of our water stations. The water was of a reddish color, and seemed to be very full of iron and sulphur. We stopped taking the water for about a week and immediately the complaint from leaky flues stopped. I am surprised to hear Mr. Hackney say that with this circulator he has an engine that can use coal mine water for a couple of months without injury to the tubes and boiler. It does look as though the device was well worth attention.

LOCOMOTIVE TIRES.

The second subject for consideration was: "Relative merits of thick and thin tires, and to what extent are the railroads moving to adopt the Master Mechanics' standard center and tire?"

President Rhodes, in the absence of the party appointed to open the discussion, made the opening address on the subject. He said:

I am going to take the matter up by first asking you to consider what advantage there is in adopting the Master Mechanics' standard. I want to speak about that particularly, because a year ago when Mr. Lauder spoke on that subject I did not see where the gain was to be in changing our standard driving-wheels to conform to what the Master Mechanics had recommended. I now see where there is great advantage. On the Chicago, Burlington & Quincy I was quite surprised to find that we carried about $8,000 worth of tire stock constantly. I found that we had a section peculiar to our road, so that it did not pay the tire companies to carry it. Now if I lay a section of our tire and of the Master Mechanics' standard together you can see they are very nearly alike. The Master Mechanics' flange is a little heaver than ours. That is about all, yet under our rules we cannot use it. When we began to consider the adoption of the Master Mechanics' standard, we found that there were several things that we did not consider perfect in what they recommended. They adopted a section, but I understand have not adopted any width of tire. That is to say, the contour lines of the flange and the tread have been adopted, but they have not adopted any width. Now it is very important that we should use a certain width, and we wrote to the chairman of the Master Mechanics' committee about it. He answered that there was considerable inclination among the master mechanics to use a tire $5\frac{3}{4}$ in. wide. That was what we were using, but some recommended a tire of $5\frac{1}{2}$ in. wide. The $5\frac{1}{2}$-in. tire is the Master Car-Builders' section, which is made $5\frac{1}{2}$ in. wide to run on tracks of varying gauges. Experience has shown that a wheel of $5\frac{1}{2}$ in. width will run on these various gauges. Now if a car wheel fitted up for a 4 ft. $8\frac{1}{2}$ in. track will run on a 4 ft. 9 in. track, the tire being $5\frac{1}{2}$ in., how much easier will it be for an engine that never has to change tracks? So that on our road, without looking into the matter at all, we adopted the $5\frac{1}{2}$ in. We save the quarter inch of metal all around.

The next question in the adoption of the Master Mechanics' standard is the gauges that should be used. I have here a set of Pratt & Whitney's gauges. We call these the Master Mechanics' gauges. The tire companies have the same gauges, and they will furnish the tire ready bored corresponding with these, and the shops should have a shop gauge, or a shop center, to which they would turn the tire, and another gauge to which they would turn the center. On our road our centers, with one exception, are all different from what the Master Mechanics have recommended. Our centers were 44 in., 53 in., 57 in. and 63 in. We find that the 44-in. center requires no change except to adopt this gauge and turn to the Master Mechanics' standard. Our 53-in. center would be compared with the Master Mechanics' 50-in., and we have not met that question yet. With our 57-in. center, by turning off a half inch on each side we get the Master Mechanics' standard 56-in. With our 63 in. center, by turning off in the same way a half inch for the spider on each side, we get the Master Mechanics' 62-in.

Some years ago we adopted a tire with the ends of the tread tapering off a little. The reasons for doing that have changed since. At that time we used a brakeshoe which rubbed on the tread at the part where the tread wore on the rail, but the Ross-Meehan shoe has come into such general use now that it really changes those conditions, and the reason for the tapering no longer exists, and in adopting the Master Mechanics' standard some roads do not wish to have the taper. Perhaps this might prevent the adoption of a standard, and at present, until some one shows some argument which I do not see just now, I would be willing to waive this tapering off now that we have shoes bearing on the flange at the outer edge of the rim. The reason for that form no longer exists. In fact, on our road we have some shoes where the flange has worn away quicker than the part of the tire that wore on the rail.

Now to consider a little the question of 3-inch and 4-inch tires. A year ago, when this matter was brought up, we presented a tabulated statement regarding tires 3 inches as against 4 inches. The practice on the Chicago, Burlington & Quincy for a number of years has been to use a 4-inch tire, and in looking up these figures we expected to find that the 4-inch tires were giving better service than 3-inch. When the paper was presented at the club it seemed to be so conclusive the other way, that without investigating as to whether the paper was quite accurate, I gave the figures, showing quite conclusively that on certain engines the 3-inch tire was decidedly more economical than the 4-inch. Since then we have gone into the matter more thoroughly, and have got a variety of results from passenger engines and from freight engines, and the figures are altogether in favor of the 3-inch tire. We are so well satisfied with it that a year ago we gave orders that tires thereafter were to be half 3-inch and half 4-inch. Last week we gave an order that no more 4-inch tires were to be ordered for the C., B. & Q. I will read you a few results that we have obtained. Here is a record of seven engines with 3-inch tires. Their first turning averages 13,382 miles per 16th; with 4-inch tire we have 9 engines, whose first turning averages 8,338 miles per 16th. At the second turning there were seven engines with 3-inch tire, averaging 12,954 miles. Of the 4-inch tire we have nine engines, averaging 8,078 miles. On the third turning we have eight engines with 3-inch tire, averaging 8,148 miles per 16th. We have four engines with 4-inch tire doing a little better than that, averaging 9,458 miles. At the fourth turning we have two engines with 3-inch tire, averaging 10,523 miles. Of the 4-inch we have two engines, averaging 5,696.

Mr. Rhodes, answering questions put by members, attributed the difference in the wear of thin and thick tires to the thick tire being less dense than the thin one, owing to receiving a less thorough working in rolling. The same difference is apparent in heads of rails. As an answer to a question the following letter was read from one of of the C., B. & Q. master mechanics: "We inclose you herewith a statement of the comparative performance of locomotive tires, 3 inches and 4 inches thick. On March 8, 1887, we ordered one set each of 3-inch tires, 44-inch, 53-inch and 57-inch inside diameters, in accordance with your letter of Feb. 23, 1887. The 44-inch tires were put in service under engine 448, on Oct. 21, 1887; the 53-inch tires under engine 95, Dec. 31, 1887, and the 57-inch tires under engine 74, Aug. 31, 1887. As they have been in service so short a time the results are necessarily incomplete. We selected three engines with the same respective weight on drivers, and in the same class of service, also having 4-inch original thickness of tires under them, of same make as the 3-inch, to make a comparison with. We find the 44-inch tires have been turned once, but the 53-inch and 57-inch 3-inch tires are still in service, not having been turned yet; the measurements of the same being taken on the 13th inst. In each of the three comparisons the 3-inch tire shows the greater average mileage. We call your especial attention to the results of the first turnings on the two sets of 44-inch tires, the 3-inch tires having made more than double the average mileage of the 4-inch tires, and that under an engine 4,400 pounds heavier. The 53-inch 3-inch tires were also at a disadvantage as compared with the 4-inch tire, the latter making one-third of their total mileage without driver brake-shoe wear, while the former had driver brake-shoe wear during the whole of their mileage."

Mr. G. W. Cushing stated that his own experience with thick and thin tires sustained the finding of the C., B. & Q. He found in traveling around the country and talking to the various master mechanics that the prevailing preference was for tires of medium thickness.

Mr. Munton, a tire maker who was called upon for his views, attributed the difference in the wear of thick and thin tires to the mechanical difficulty that interfered with the proper working of a thick section under the rolls.

Mr. Stevenson, of the Standard Tire Company, spoke of the advantages which would accrue all round from the adoption by railroads generally of a standard section of tire. Thought there was no doubt that the difference in wear of tires was due to the difference in working those of thick and thin section.

Mr. Fowler, maker of the well known rolled cast-steel wheel, described the process of making his wheel, in which the metal is compressed under the rolls. He said that the effect of the compression is visible about $\frac{5}{8}$ inch under the surface of the metal. Believed this peculiarity would greatly increase the wearing qualities of his wheel.

Mr. Wm. Swanston, Pittsburgh, Cincinnati & St. Louis, cited a case where one set of 3-inch tires made double the mileage of another set, and they were under engines of exactly the same weight. Found lately that another set of tires of the kind that had worn badly were still in good shape after 141,000 miles of service. So that there is a marked difference in the service got from 3 inch tires. He preferred to have a wheel center $5\frac{1}{2}$ inches wide and the tire a little wider. Thought that width was necessary to prevent tires from working loose.

Mr. Jacob Johann had always been an advocate of using standards. As early as 1860, he had begun working for uniformity of tire shapes on a road where he had charge of 65 engines, and by some labor succeeded in reducing the diversity of forms from about 30 to 4. He doubted the truth of the theory that there was any difference in the density of metal in 3-inch and 4-inch tires. Thought the difference in wear of tires did not depend so much on difference of quality as upon difference in the way the engines were handled. A man who handles his engine carefully will get twice the wear out of tires that another man will do who wears out the tires by slipping the wheels. In a test which he made of crucible steel and open-hearth steel tires, he found that the latter gave a little the better service.

The Northwest Railroad Club was organized in St. Paul, Minn., last month, and meetings will be held regularly on the 5th of each month. We would offer to this club the suggestion that they make their meetings on a certain day of the week nearest to the 5th of each month. Experience with railroad men's duties convinces us that this would be much more convenient for the members than having a fixed day of the month. The club appears likely to receive cordial support from the railroad men of the Northwest. Mr. W. T. Small, of the Northern Pacific, occupied the chair at the preliminary meeting, and Mr. Harry P. Robinson, of the *Northwestern Railroader*, acted as secretary. The charter members consist of W. T. Small, J. C. Barber, S. L. Bean and A. Bardsley, of the Northern Pacific; W. T. Reed, Chicago, St. Paul & Kansas City; J. O. Pattee and John Taylor, Chicago, Milwaukee & St. Paul; Matt. Ellis, J. J. Ellis and H. L. Preston, Chicago, St. Paul, Minneapolis & Omaha; Wm. McIntosh, Chicago & Northwestern; C. F. Ward, St. Paul & Duluth; G. F. Wilson, Minneapolis & St. Louis; J. Evans, Oregon Railway & Navigation Company; T. A. Frazer, Minneapolis, St. Paul & St. Marie; L. Greatsinger, Duluth & Iron Ridge; R. W. Bushnell, Burlington, Cedar Rapids & Northern; W. Comack, Wisconsin Central; C. B. Brunson, Union Depot; H. Higgins, St. Paul, Minneapolis & Manitoba.

A valuable test of metal sleepers is about to be made by the New York Central & Hudson River, about a third of a mile of steel ties having been ordered for use on the Hudson River division. The tie which will be tried is rolled from soft steel, 5-16 inch thick in the body and $\frac{1}{2}$ inch thick in the flanges.

Railway Car Construction.

BY WILLIAM VOSS.

Fourth Paper.

SHEATHING.

The exterior of the frame is covered with dressed and matched boards, usually of white pine. This lumber is preferred, as it is the most suitable to be obtained for the purpose, but where its price is much higher than yellow pine, this latter lumber is frequently substituted. Yellow pine is somewhat heavier, more liable to split and check, and does not hold the paint so well, but, on the whole, makes a satisfactory siding. The quality of the lumber used should be fair; that is, it should be reasonably free from sap and all other defects which would in time impair its usefulness as a protection against the weather. The shrinkage of the boards at their edges, so commonly met with, and often to such an extent that the tongued and grooved edges fail to make the secure joint they are intended for, and it becomes necessary to renew the boarding for no other reason than this, can be prevented only by using thoroughly seasoned material. The importance of using seasoned lumber is well understood, but the difficulties in the way of obtaining it are many. The diversity of the sizes of framing timber make it an impossibility for the manufacturer to furnish these in a seasoned condition when receiving an order for a large number of cars, and deliver them at a specified time, which is usually made as early as possible. Railroad companies building their own cars can be prepared by buying the stock in advance, but as this requires an outlay of money which does not bring immediate returns, and as the number of cars it is expected to build is not known until wanted, this is but seldom done, and by rich and large corporations only. The lumber used for the covering of the frame and roof is not so much subject to these conditions. It is of the same kind and dimensions as used for house and other building purposes, and can be purchased at short notice already seasoned, and if not entirely in proper condition for use, can in a very short time be prepared by means of dry kilns.

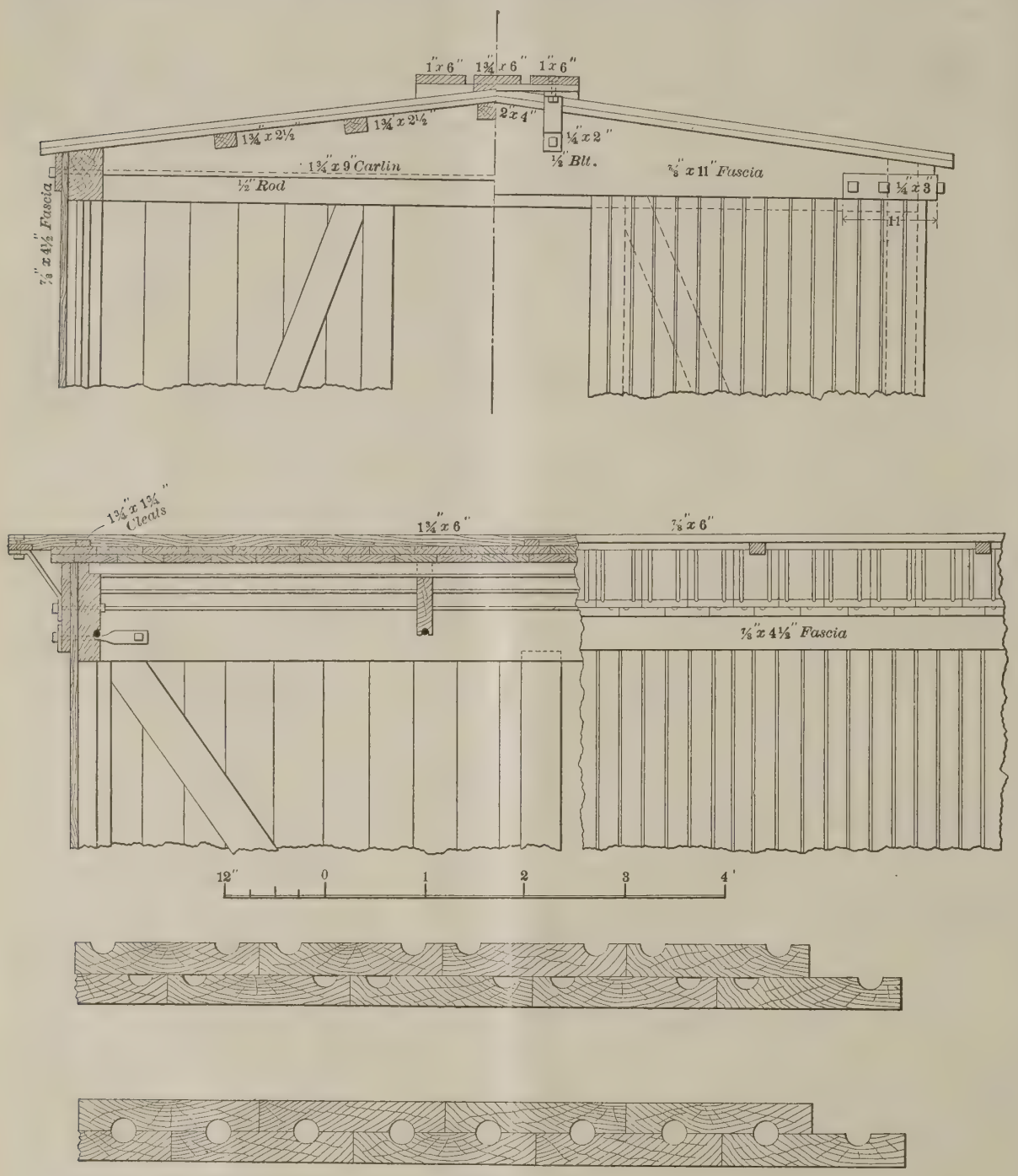


Fig. 42

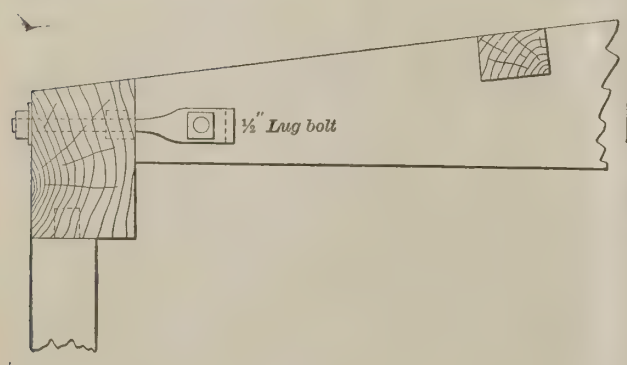


Fig. 43

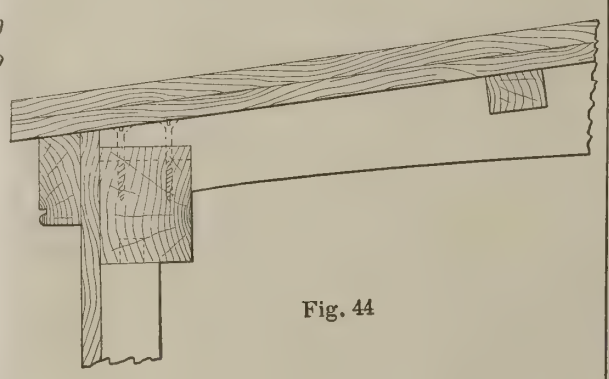


Fig. 44

The boards are surfaced on both sides to a thickness of from ⅞ to ⅞ of an inch, tongued and grooved as stated, and beaded on the face side to present a more finished appearance. They are as a rule applied with vertical joints, and secured to the side sills and plates with five and three respectively 3 inch No. 9, to the end sills and plates with five and three 2½ inch No. 10, and to the girths with three 2 inch No. 11 wire nails. This number of nails is used when the boards are from 5 to 6 inches wide, and is correspondingly less for narrower strips. The steel wire nails, both barbed and smooth, have lately come into general use, and in car construction have entirely superseded the cut nails. The latter when made of iron have a tendency to break off, and when this difficulty is overcome by making them extra heavy like fence nails, they will work loose from the constant strainings and vibrations of the frame. The weak spot of the steel wire nail is the head, which, it is complained, very easily separates from the body of the nail; this is to a great extent overcome by making the head of ample thickness and with an oval face, thereby avoiding the side blows of the hammer.

The sheathing has also been put on with horizontal joints, thus being utilized to strengthen the side frame vertically; but what is gained in this direction is perhaps offset by the loss in another; the vertical boards being better adapted to resist the side pressure. The connection of the horizontal boards with the door and corner posts as commonly made is objectionable, in that it allows moisture to collect and cause decay; especially is this the case at the lower corner iron when that is used.

ROOFS.

A satisfactory if not a perfect freight car roof is one of the problems still to be solved, and considering the conditions of service involved, it is safe to say that it will remain a problem for some time to come. The first requisite of a good roof is an absolute protection against rain; it must also be reasonably safe to walk over, and consequently of a low pitch and of a material that is not slippery and not liable to be injured by the feet of trainmen; the construction must be such that the vibrations and the twisting of the frame will have no effect on it, and lastly, it must be durable and reasonably cheap.

There are three distinct classes of roofs in use, and their relative value, if measured by the number at present applied, is in the same order as they are mentioned: First, the double board roofs; second, the single board roofs covered with tin or some other sheet metal, and third, the various roofs of sheet metal, paper or composition, with an outside, and in some instances, also, with an inside covering of boards to protect this material against injury.

The double board roof cannot be depended upon as absolutely tight, even when new, but as it meets all the other conditions fairly well, it is still the favorite with many prominent roads, and will probably continue so until the test of time has proved another one decidedly superior. None but a high grade of white pine should be used for the boards this roof is composed of; any imperfect pieces should be rejected, as they will cause the roof to give out in spots, and often condemn the whole when only a part of it is worn out. The culled pieces can be used for patching an old roof or on an inferior class of cars, on which a tight roof is not imperative. The boards are dressed on both sides and edges to a uniform size of about $\frac{7}{8} \times 5\frac{1}{2}$ inches, and have two semi-circular grooves of $\frac{5}{8}$ of an inch diameter on one side, one near each edge. The intention of these grooves is, in the top course, to catch as much of the water as possible, thus keeping it out of the joints; the grooves in the lower course convey the portion that penetrates the joints in the upper. The fact that the lower grooves, because of their small size, are very apt to become clogged with cinders and dust, has induced some builders to place the two grooved sides in contact, thereby doubling the size of the openings. Both methods are shown in Fig. 42. The boards in the lower course are secured with 2-inch No. 11, and those in the upper with 3¼-inch No. 9 wire nails, two of which are used to every bearing, and sometimes three at the end, two in the plate and one in the cornice. Wood screws have been used for this purpose, but not so much since wire nails were introduced; they are much more expensive and troublesome to apply. A heavy coat of paint is usually applied to all the edges and faces in contact before the boards are laid. The pitch of the roof varies from 1¼ to 2 inches rise per foot, or from 5 to 9 inches for a car 8 feet 6 inches wide over the side sills, the steeper pitch making a more secure roof, but one that is also more dangerous to the trainmen. The manner of framing the supports is shown in Figs. 32, 39 and 42. The upper edges of the side plates are beveled to correspond to the pitch; the combines of about 1¾ by 9-inch oak are placed from 3 to 4 feet apart, and are framed to the plates with mortise and tenon; a ½-inch rod, usually placed at every other combine, ties the top of the frame. Owing to the shrinkage of the plates, these rods frequently become slack and are therefore placed in grooves provided in the side of the carlines or are secured to them by staples. To admit of the tightening of these rods, as well as those at the end plates, they can be made to extend through the siding and fascia with the nuts on the outside, as in Fig. 42.

Fig. 43 shows the manner of fastening when these rods are not used; in one case this is effected by lug bolts attached to the ends of the carlines and end plates, and in the other by short rods extending from and through the side plate to the first roof strip. Fig. 44 is a more simple way of framing the carlines to the plates, and one that is much used now. The carlines are secured to the plates with long nails or screws, and the above mentioned bolts and rods are in this case frequently omitted. The roof boards, not coming in contact with the plates, are nailed

to the fascia, which should not be less than 1¾ inches thick. To avoid this somewhat weak arrangement the space above the plate can be filled with blocks of suitable shape and properly fastened to them and the roof boards nailed to these.

Both the center and intermediate nailing or roof strips should be of oak, as this lumber will not split so readily from the numerous nails driven into it, and will also hold

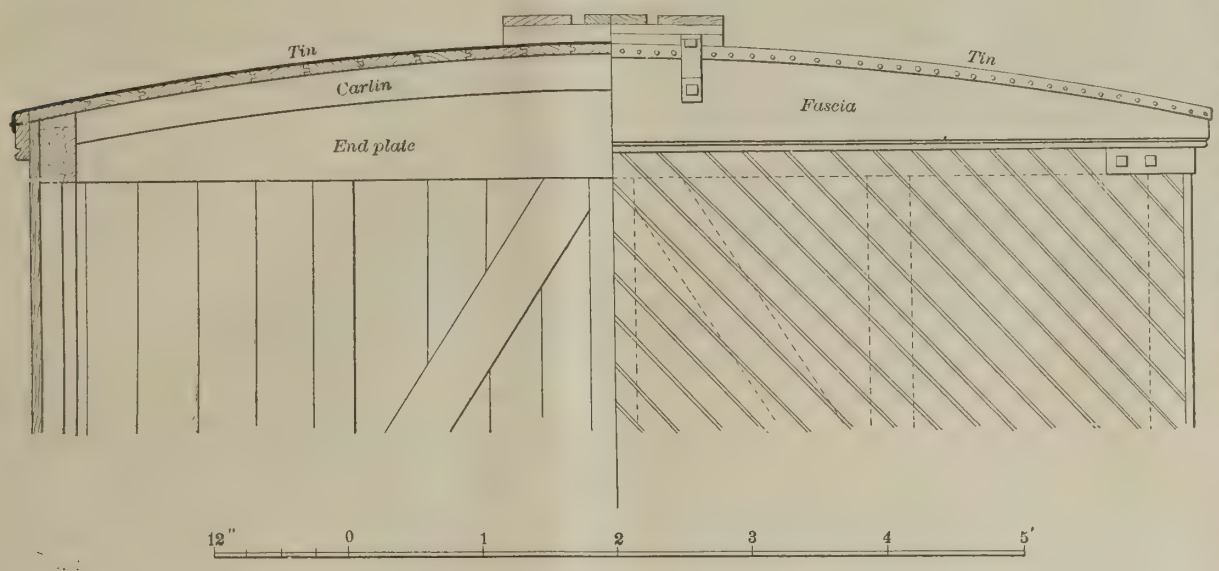
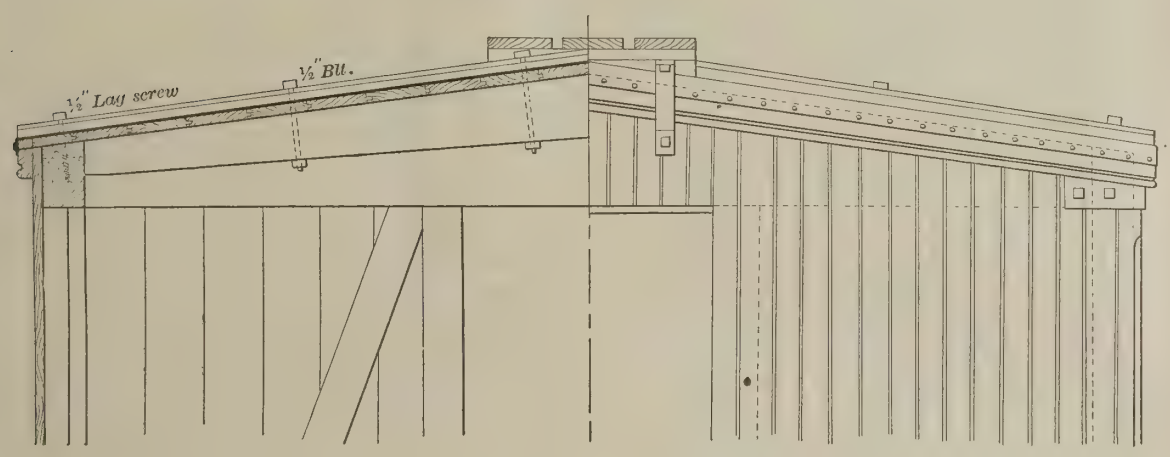


Fig. 45



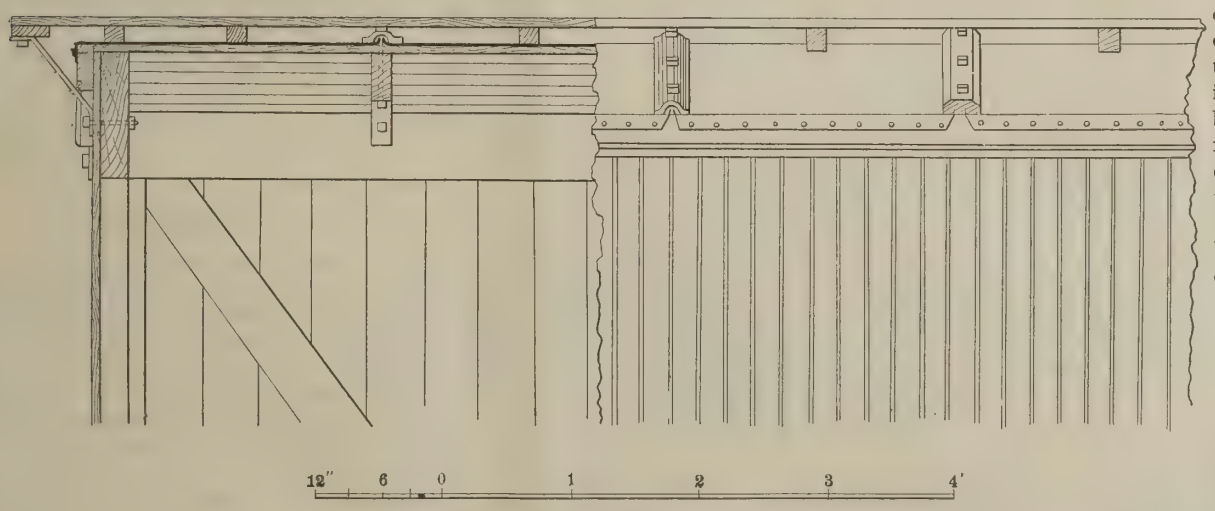


Fig. 46

these much better. These strips are fastened to the end plates and carlines with either nails or screws.

The cost of a tin roof is not much in excess of a first class double board roof, and if it were in all other respects perfectly satisfactory would perhaps be more used than it is. Its objectionable features are the liability to injury from being walked over and the difficulty experienced in attaching the running boards, grab irons and brake rest, all of which are apt to wear holes in the covering by chafing. The usual method of constructing this roof is represented by Fig. 45. The outline is a curve with a rise of from 5 to 6 inches; the carlines are more numerous but not so heavy in the center; they are fitted to notches in the plates and fastened with screws the same as those in Fig. 44, the rods also being omitted. The sheathing, which is a cheap grade of dressed and matched pine, is applied with longitudinal joints and nailed directly to the carlines, the whole making a neat and very strong top.

The fragility of tin has led to the use of sheet iron or steel of considerable thickness as a substitute. As this material cannot be shaped and worked the same as tin, it is necessary to lay it with standing seams instead of the locked and soldered seams of the latter, and this requires a roof shaped with straight lines. Fig. 46 shows the usual manner of applying it. With the exception of the curved outline, the roof is framed and sheathed the same as that of Fig. 45. The iron sheets of the same width as the distance between the combines are laid parallel to these, with the ends turned down over the fascia and nailed to it.

The standing edges of two adjoining sheets engage with saw cuts provided in the cleats of wood, which serve as joint covers and which are fastened with lag screws extending through the sheathing and into the carlines. These joint cleats are also frequently made of cast iron, fastened in a similar manner, a piece of painted canvas being inserted between them and the roofing sheets to make the joints more secure. The same material is put under the running board cleats and washers cut from it under the handle and all other screws necessary for the fastening of the different attachments.

The roofs coming under the third class are more numerous, and can, therefore, not all be described in detail. They are in some respects a combination of the other two, the roofing material proper consisting of light galvanized sheet iron or prepared paper placed directly on the carlines or roof strips or on a course of matched boards like that described in Figs. 45 and 46, while above this is constructed a wood covering, resembling the ordinary board roof. The lumber used for this may be of a cheaper quality, as any water penetrating this cover will be conducted to the eaves by the roofing material underneath. To admit this a space is provided between the two roofs and also between the fascia proper and the subfascia. The latter is blocked out from the car, and fastened with long nails or ½ inch bolts with the nuts on the inside of the side plate. The subpurlins, to which the boarding is nailed, are secured to the carlines protruding through the underoof or to cleats placed on top of the latter, which cleats are nailed or screwed to the carlines or roof strips proper. Fig. 47 shows the construction of one of these roofs in detail.

RUNNING BOARDS.

The simplest and most durable running board is a 12 inch plank shaped on its underside to conform to the outline of the roof, to which it is secured with nails or screws. A sheet of tin is inserted where these plank abut; that is, when they cannot be procured of sufficient length to reach from one end of the roof to the other.

The extreme narrowness of this running-board is the only objection to it. The M. C. B. Association have recommended it to be not less than 18 inches in width, which is wider than it is practicable to construct it with a single board or plank. It is therefore usually made of three 1 by 6 inch strips which are supported on hard wood cleats provided at proper intervals. To make the passage from one car to another less dangerous, the running board is extended 5½ inches beyond the end boarding, the extension being supported by 2 wrought iron brackets and a hard wood cleat securely fastened with bolts and lag screws. Fig. 42 shows the above as commonly applied to a double board roof; the two outside boards are one inch, while the center strip is 2 inches thick and is fitted to the roof the same as the single plank described, with the object of protecting the roof-ridge, The lower side of this strip is notched to fit over the cleats, permitting these to be made in one piece, a more satisfactory and substantial arrangement than the short blocks toenailed to the sides of this strip.

On tin and iron roofs, there being no ridge to cover, the center strip is made of the same size as those on the side. In one case the cleats are held in place by strips of tin soldered to the roof and in the other they are screwed to the roof-boards or purlins, the screws passing through the iron covering. Small platforms, termed "roof steps," are often used on this class of roofs; they are placed at the two diagonal corners of the car corresponding with the location of the ladders. Their construction and fastening is identical with that of the running board, and the object being the protection of the roofing material, they usually follow the curve or pitch of the roof, but in some cases are elevated on their outer end enough to make them level with the running board.

Fig. 47 shows a roof construction, in which a part of the boarding is applied horizontally, and is thereby made to do service as a running-board; this is used in connection with the third class of roofs described only.

ATTACHMENTS FOR THE SAFETY OF TRAINMEN.

These consist of steps, ladders and handles, by means of which the trainmen ascend to the roof, where the appliances for working the hand-brake are located. Uniformity in their location, dimensions and manner of fastening is very desirable and important, but, notwithstanding that the M. C. B. Association has to some extent provided for this by selecting the ends of the car near the left hand

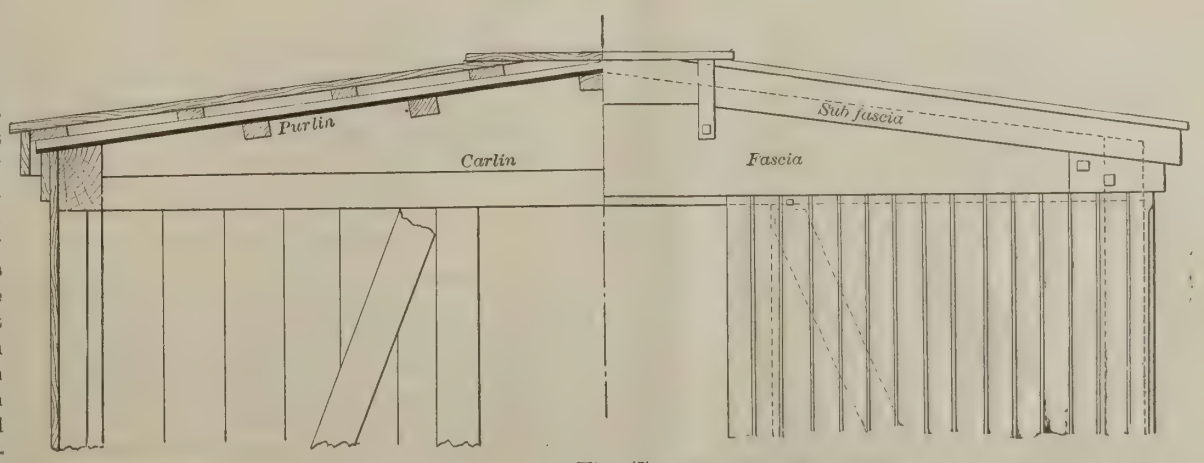


Fig. 47

corner as the proper place for the ladders, does not promise to be effected in the near future. A large number of roads considering the ladders on the side less dangerous and more convenient to mount cannot be induced to place them at the ends, and as long as it is impossible

to agree on the location it is equally so to agree on the details of construction.

The two methods in question are shown in Figs. 48 and 49. The ladder irons, five in number, are made of $\frac{5}{8}$ inch round bars, when formed to the required shape are 20 inches long and extend $3\frac{1}{2}$ inches from the face of the siding. They are usually fastened with a $\frac{1}{2}$ by $3\frac{1}{2}$-inch lag screw at each end, one end to the corner post and the other to a cripple post 4 inches wide and of a thickness corresponding with the side or end framing. The lower iron, in case the ladder is placed at the end, is shaped with an offset or projection to guard the foot of the person when swinging around the corner from the step.

The end ladders are also frequently constructed with side pieces of $1\frac{1}{4}$ by $3\frac{1}{2}$ inch hard wood, securely fastened to the frame of the car, and to which the irons are bolted or inserted in holes provided for this purpose, similar to the construction of an ordinary ladder.

Steps made of $\frac{1}{2}$ by $1\frac{1}{4}$ inch flat or 1 inch round bar iron, with an opening 10 inches wide and extending 8 inches

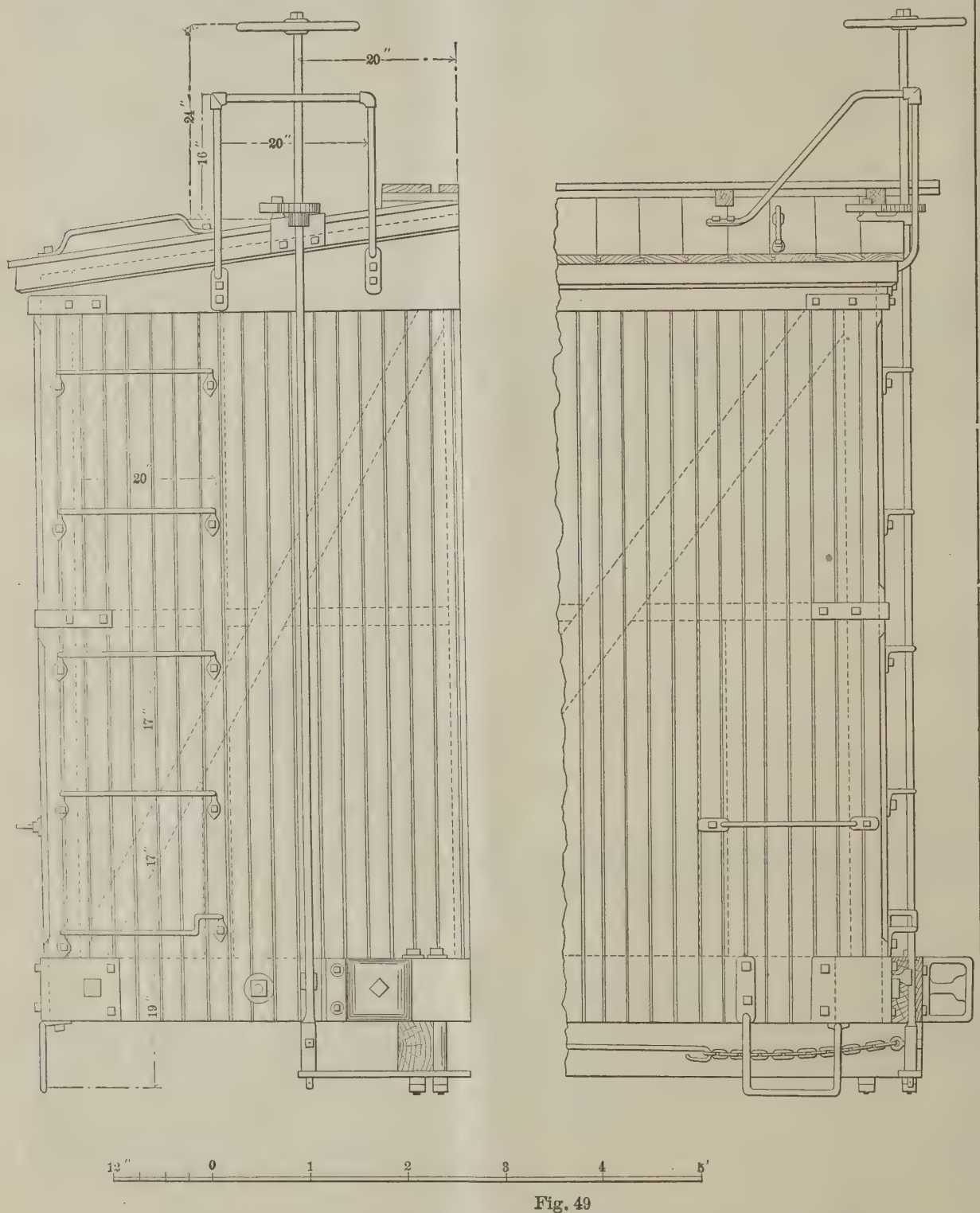


Fig. 49

below the body of the car, are placed at the corners corresponding with the ladders, parallel with and fastened to the side sills. The fastening may be done with lag screws or bolts, and to the under side or to the face of the sill. When end ladders are used it is necessary to have a handle above the step; this, like all the other handles used, is of a similar form and size as the ladder irons and is usually placed in a vertical position with both ends fastened to the corner post. A better position for it is the one recommended by the M. C. B. Association, in which it is placed horizontally 24 inches from the bottom of the sill. This necessitates an extra cripple post to fasten it to, which is, perhaps, the reason it is so seldom used.

A handle or grab iron is fastened to the roof immediately above the ladder, the proper position of which is parrallel with the ladder and from 12 to 15 inches from the edge of the roof boards. Handles are frequently provided on the ends of the car, by means of which the person operating the coupler can sustain himself if he should lose his foothold. They are either fastened to the end sill or 24 inches from the bottom of this and on a line with that above the steps. To accomplish the passage from a box to a gondola car, or the drawing of a coupling pin while the train is in motion, it is necessary in the case of side ladders to have a horizontal handle about 3 feet from the lower edge on the left side of the end, the handle at the end sill being used as a step.

The brake-shaft is placed at the end of the car from 17 to 20 inches to the left of the center. Its lower end is supported by a bracket of wrought or cast iron bolted to the end sill or by an extension of the draw-bar carry-iron. A cast iron rest or box is provided to prevent the springing of the rod, and is usually fastened to the end sill with lag screws. The upper end of the shaft is guided by a casting now generally placed on the roof, and attached to which is a pawl engaging with the ratchet wheel keyed to the shaft. At the upper extremity of the shaft, which terminates 24 inches above the roof, is a cast iron hand-wheel of 16 inches diameter attached with a square socket and a $\frac{3}{4}$-inch nut.

The hand-rail surrounding the brake-shaft is a recent addition; it is constructed of wrought iron pipe and ordinary fittings; it is 16 inches high and extends 20 inches from the edge of the running-board towards the left-hand corner with the foot of the brace 24 inches from the end of the roof. The uprights have flat ends welded to them. by which they are attached to the end plate with two $\frac{1}{2} \times 3\frac{1}{2}$ inch lag screws or $\frac{1}{2}$-inch bolts in each.

Fast Running in the West.

We have received from Mr. Ripley, general manager of the Chicago, Burlington & Quincy Railroad, the following particulars of fast running made on the road named:

In view of the fact that considerable has been said, particularly in the New England Railway Club, about the time made by some of the fast trains of eastern lines, it may be interesting to know what is being done by our western roads.

Nov. 20 the Fast Mail on the Burlington, leaving Chicago at 3:00 A. M., arrived at Galva 55 minutes late, on account of running hot on one of the engine truck bearings. It could not be cooled; and finally at Galva the engine was cut off, and a freight engine [No. 339, Class A 17 × 24, built at Baldwin's, September, 1879] and freight engineer took the train, bringing it to Gatesburg ($23\frac{1}{2}$ miles) in 29 minutes.

At 8:05 A. M. (48 minutes late) engine No. 153, standard class A 18 × 24, left Galesburg with delayed fast mail train, composed of three six-wheeled mail cars, 60 feet long, of 18 tons capacity each, and fully loaded. The train arrived at Burlington (43.3 miles distant) at 8:58 A. M., making the run, including stops, in 53 minutes, or at a rate of 49 miles per hour. The train left Burlington at 8:05 A. M. (30 minutes late), arriving at Ottumwa on time at 10:40 A. M., making the run from Burlington (75.2 miles distant) in 1 hour and 35 minutes, including all stops, or an average of $47\frac{1}{2}$ miles per hour. The train struck its time at Batavia, 13 miles east of Ottumwa station, so that had it been required from Batavia, another five or six minutes more could easily have been added to the record. It will be seen, therefore, that the run as it stands from Galesburg to Ottumwa (118.5 miles), including all stops, was made in 2 hours and 35 minutes, an average of $45\frac{7}{8}$ miles per hour. Deduct from the run the time that the following stops would represent:

First—Central Ia. R. R. Crossing at Monmouth, full stop, estimated	1 min.
Second—Monmouth Station, regular stop, transferring mail, full stop, estimated	4 "
Third—Carthage Junction, slow up, estimated	1 "
Fourth—Burlington Draw bridge, full stop, estimated	1 "
Fifth—Burlington Depot, regular stop, full stop, actual	7 "
Sixth—New London, for water, full stop, estimated	4 "
Seventh—Mount Pleasant, regular stop, full stop, estimated	3 "
Eighth—Fairfield. regular stop, full stop, estimated	3 "
Ninth—C., R. I. & P. Crossing, beween E. & W., Ottumwa, full stop, estimated	1 "
Total	25 min.

And the average speed between Galesburg and Burlington is 43.3 miles in 46 minutes, or 56.48 miles per hour, between Burlington and Ottumwa (75.2 miles) in 77 minutes, or 59 miles per hour. The whole distance between Galesburg and Ottumwa (exclusive of stops, 118.5 miles) in 123 minutes, or 57.8 miles per hour. The time lost in slowing up and starting at stopping places not being taken into account, the actual running speed must frequently have been up to 70 miles per hour for short stretches.

We are informed that the order has been issued that in future all freight cars of the Pennsylvania Company shall be equipped with an automatic coupler of the M. C. B. type, and that all box and stock cars shall be fitted with the air brake. Orders will be placed very shortly for 4,000 cars for freight service, all of which will be fitted with the Janney coupler, and all but 500 (gondolas) will have the Westinghouse brake. We understand that the latest form of draft-rigging of the Pennsylvania Railroad is especially designed to facilitate the change from their standard link and pin draw-head to one of the M. C. B. type as fast as it is found desirable to make such a change. The action of the Pennsylvania lines in this matter is of great importance. It carries weight from the high reputation of the mechanical departments of those lines, and will have a direct influence on connecting roads reaching over a great area. The dangers of coupling are certainly not diminished, and are probably increased where cars fitted with the old and the new couplers are brought together, while the benefits of close coupling are not realized. And so of the air brake, the advantages from its use are only to be fully felt when it is so generally used that freight trains can, as a rule, be controlled by it. These are among the chief obstacles to the rapid introduction of these particular improvements. We may expect, therefore, that their use will increase at an accelerated rate. Each new application of them helps to remove the objections to further applications.—*Gazette.*

Economy of High-Pressure Steam.

The *Locomotive Fireman's Magazine* encourages the members to write letters concerning the best way to do their work and on matters pertaining to the practical working of the locomotives generally, and a great many interesting facts are elicited which must do a good educational work on the future locomotive engineers of the country. The following extract from a practical man's letter indicates that some of these men are remarkably well informed on difficult problems of steam engineering:

I select for the object of my modest contribution the practical question asked by "Vulcan" about the difference in steam used with 120 and 130 pounds of pressure. "Vulcan," I see, likes to reason and find the relationship between cause and effect. He is a firm believer in the method of regulating speed by the reverse lever, with full throttle, or in other words by keeping the pressure at the cylinder always as near as possible to that of the boiler, and simply varying the point of "cut-off." He also believes that a little humanity and sympathy toward the "boy who is trying to keep her hot" is commendable, and prescribes the exercise of memory to keep in view the fact when *we* were "boys." "Vulcan's" advice is, in my judgment, of the very choicest in both instances, and I do not know whether it be intentional on his part or not, but his little problem is just what gives one a chance to "clinch" the question. The fact is that if the engineer who is at the throttle on both trips is one of the kind that believes in the good old fashioned way of regulating by the throttle only, the firemen would probably never know the difference between the two trips so far as labor and coal are concerned, and I doubt if the master mechanic or the best steam expert on the road could answer the question more satisfactorily. On the other hand if the engineer is of the modern school, and confines his attention to the cut-off leaving the throttle wide open, there *will be* a difference, which can be estimated by reference to the well-known laws of the effi-

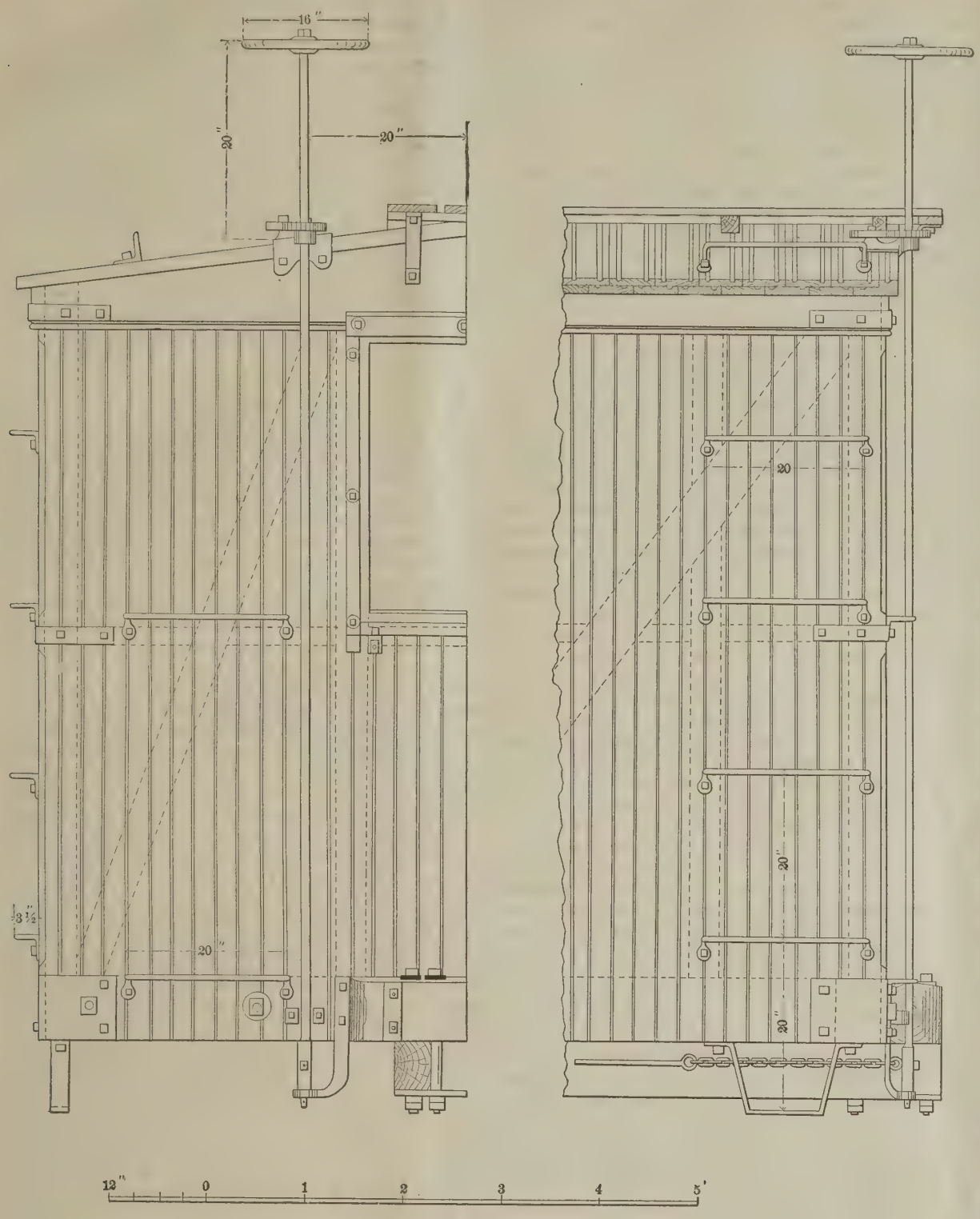


Fig. 48

ciency of all engines in which heat is the primary agency. Neglecting for a moment the gain in efficiency due to the shorter cut-off, the higher pressure of 130 pounds, will, as compared with the pressure of 120 pounds, represent a saving of about four per cent. in round numbers, due to the simple difference of temperature between steam of 130 and 120 pounds. But as just stated the higher pressure, if given full play up to the cylinder parts by a wide throttle will reduce the cut-off, and the losses *in the cylinder* will be diminished. We have no definite means of estimating the precise amount of benefit, but we know that it is something, certainly not less than one or two per cent. To sum up, therefore, the pressure of 130 pounds, when used with a fully opened throttle, will effect a saving of not less than four per cent. as compared with a pressure of 120 pounds, where the same work is to be done under identical conditions, and the fireman would find that for every 100 pounds of coal used at 120 pounds he would get along with 96, and possibly less, at 130 pounds. When the firemen know this fact, and when the engineers also realize it, then they will both see that it is an object after all to keep her hot right up to the top notch, and while they will thus virtually lighten their task the company will have cause to commend them for economizing coal. The law that underlies this question is almost as unquestionable as that of gravitation.

The Lehigh Valley Railroad now has twelve trains equipped with telegraphic instruments for transmitting messages to points along the road while the trains are in motion.

The New York, Lake Erie & Western road will close its shops at Susquehanna, Pa., which employed about 200 men, it having been decided to have the work performed by outside contractors.

The New Jersey & New York shops, at Hillsdale, N. J., have lately been extended to twice their usual size. A new 40 H. P. engine has been added, two new lathes and a quantity of other small machinery.

The Southern Pacific recently purchased 60 acres of land in East Los Angeles, Cal., as a location for locomotive shops. Plans have been drawn for 15 large brick buildings, including machine shops, paint shops, carpenter shops, foundries, etc. Work is expected to begin about Jan. 1.

The Baltimore & Ohio Railroad Company are building some consolidation engines in the shops at Baltimore. The cylinders are 21 × 26 inches, and the diameter of wheel is 50 inches. The boiler is 55 inches diameter and has 198 flues 2¼ inches diameter. The total weight of the engine is 134,000 pounds.

The Canadian Locomotive Works at Kingston, Ont., have lately completed 14 locomotives for the International Railway designed by Mr. H. A. Whitney, mechanical superintendent of the road. They are eight-wheel engines, with cylinders 18× 24 inches, and driving-wheels 62 inches in diameter. The total weight of the engines is 99,750 pounds, 63,200 pounds being on the drivers. They are now working on an order of 20 mogul engines designed by Mr. F. R. F. Brown, for the Canadian Pacific. These engines have cylinders 18 × 24 inches, and the driving-wheels are 57 inches diameter. The total weight on the drivers is 98,000 pounds, and there is 14,000 pounds on the pony truck. The boiler carries a working pressure of 175 pounds.

A correspondent of *Industries* writes to that journal that the Russian Minister of Ways of Communication proposes asking for a credit of 9,300,000 roubles for a purchase of 300 locomotives, at an average price of 31,000 roubles each. This, at the nominal value of the rouble, 75 cents, would make their cost $23,250 each, and the total sum sufficient to purchase over 700 locomotives in this country. The value of the paper rouble has risen from 38.6 cents in February to 46 in June, and a fair average value for that time is very near 41 cents. This would bring the cost of the engines to $12,710 each. These engines are all to be built in Russian shops, and an order for 20 has already been placed.

The demand for oak lumber for car building purposes is said to be increasing.

The new shops of the Canadian Pacific at Montreal when completed will give employment to a thousand hands.

The Schenectady Locomotive Works have lately turned out 15 ten-wheelers for the Southern Pacific, with cylinders 18 × 24 inches; four of the same type were also delivered to the Chesapeake, Ohio & Southwestern, and one to the Mexican International. Twenty twelve-wheelers, with cylinders 20 × 26, were delivered to the Southern Pacific; two 18 × 24 switchers for the Belt Railway, of Chicago, and one 17 × 24 eight-wheeler for the Dayton & Union. The works are running full time, turning out about 28 engines a month with a force of 1,500 men.

The occupants of a sleeping-car on a road running into Chicago were cleaned out by a thief a few nights ago. Among the victims was a Detroiter. In the morning, when the losses became known, the conductor went through the car to take down names and amounts. "What was your loss?" asked the Detroiter of his seat-mate. "It was $17, but I shall say $150. What was yours?" "Only $13, and I shall give in the true figures." "You're a fool to do it!" "Well; I only want what I lost." When the conductor came along he inquired, "Well, gents; give me names and amounts, please." "My name is Smith, of Milwaukee, and I lost just $150.50," replied the one. "All right, all right; the company will promptly make good the loss. And you?" "My name is Blank, of Detroit," replied the Detroiter, "and my loss was only $13." "Thirteen dollars, eh! All right. The company will make a rigid investigation of your case. Something very suspicious about it, very. You may be the chap who did the robbing."—*Detroit Free Press.*

The mechanical department of the Chesapeake & Ohio have lately put in service combination box cars, which are thus described by the officers of the company:

This car was designed to fill a want long felt on a great many roads, very prominently amongst them the Chesapeake & Ohio. We ship coal in large quantities from Virginia and West Virginia to points as far west as Chicago, and to have to return these cars empty that distance causes a great loss to all parties handling them, as was the case with the plain gondola, a large number of which we put in that trade. After considerable attention was given the matter, a car was designed that could be readily loaded at our chutes (through the coal doors) sent west with coal and returned east with grain or merchandise, having positive assurance that same would not be damaged by water. The door sills are framed in solid, coming flush with outside and rabbeted on a bevel on the bottom to receive the siding, and using a flush door. The car is lined on the inside to the roof, so that it can be easily swept out after being loaded with coal. We also had to change our grain door, as no slide door can be used in connection with coal or coke. The door we have adopted is known as the Jackson patent, and opens out from the car, freeing itself under all circumstances. The door is attached to the car body by a strong chain to prevent its being lost. The car is made strong and heavy to stand the service it will be placed in.

Extensive new car works are under construction at Duluth, Minn., for the Minnesota Car Company. The foundation for the foundry building is of Fond Du Lac sandstone, and was completed several weeks ago. The walls will be constructed of Menominee brick, and will be 12 inches in thickness, pilasters being 20 inches.

The dimensions of the foundry are 383 by 61 feet, and the height will be 20 feet to top of wall. Attached to this will be the pattern room, core rooms, shaving shed and boiler rooms. The roof will be of iron, as will the roofs of all the other buildings included in the plant.

The dimensions of the rolling-mill are 161 by 80 feet, and those of the forge and axle shop adjoining it are 100 by 70 feet. The boiler house and gas producers near it are to be 100 by 40 feet on the ground, and will be built on the lower level, where the coal can be delivered much more easily.

A scrap shed and shear shed will be built on the east of the rolling mill.

The machine shop is west of the foundry, and the inside dimensions are 526 by 94 feet. It will be lighted overhead by a clear story 14 feet and 2 inches wide, with five foot windows. This will extend the entire length of the building, which will be frame, with corrugated iron roof.

The paint shop on the extreme west will be 361 by 57 feet, and of the uniform height of 26 feet to wall plate. A transfer table will serve the car and paint shops, and the plant will be furnished with a complete system of trackage. The equipment of tools will be new throughout and of the most approved patterns of the best builders. The works are located at Grassy Point, on the St. Louis Bay, and are reached by the Short Line trains.

The officers of the company are: President, J. F. S. Anderson; general manager, Col. W. E. Tanner; superintendent, G. H. White.—*Northwestern Railroader.*

Communications.

Combustion Chambers.

Editor National Car and Locomotive Builder:

Your note of 4th inst. duly received.

I do not feel able to say anything new on combustion chambers, as the subject has so often been up as to be threadbare. The essay read before the last meeting of Western Railway Club went over the ground pretty thoroughly, but as you ask for individual experience I will reply accordingly.

In the early days of coal-burning in Illinois I was placed in a position to know what was done with coal, and I have followed the subject pretty thoroughly since. Combustion chambers formed within the boiler shell were used on a few of the wood-burning engines, with chambers 12 to 18 inches deep, but there never seemed to be necessity for them in any good or economical results developed. When these engines were changed to coal-burning, the combustion chamber seemed to have an advantage, as compared with the ordinary straight fire-box, and this continued until the trouble in regard to the rapid wearing away of the sheet at point of its connection with the throat sheet was developed. This was caused by particles of coal passing over, and within a brief time patching of the sheet became necessary and the repairs and renewals of patches became very annoying. This led to investigation of the subject and inquiry as to the real value of the chamber, and it was found that it had value as a smoke preventer, and to a slight extent as a fuel saver, if the flues were not shortened to an injurious extent, but in the case of deep combustion chambers there was a loss in heating surface which was felt in the engine performance. The trouble with throat sheet continued, however, regardless of length of chamber, and it led to the brick arch being used as a protection, and a very great improvement in the steaming of engines resulted. The same result followed the use of arch in the plain fire-box, however, and in the renewals of fire-boxes, as also in new boilers, the combustion chamber was not used and the brick arch, for the time, came into great favor, new engines being made with fire-boxes from one to two feet longer.

I recollect reporting to the Master Mechanics' Association several times in favor of the arch, and for deep and long fire-boxes. The master mechanics of the time seemed to agree upon this, and especially Messrs. Sellers, Hayes and Jauriet.

The Jauriet water-leg fire-box was used generally, I believe, with a short combustion chamber, but with the only apparent effect of transfer of the throat trouble to the water-leg itself. With the plain box the Jauriet leg was used for a number of years. It aided combustion by deflecting flame and heat, and the prevention of smoke. It was of value also as a water circulator, there being very much less difficulty with mud and scale in boilers fitted with it; with this it was also usual to admit air above the flame through side stay bolts. As compared with the brick arch, however, the water-leg was expensive to maintain, and of less value as a fuel saver and smoke preventer.

In anthracite coal burning, the combustion chamber is used in the Wootten boiler, and is a necessary part of the system, chiefly because it permits of the building of a brick wall just within the chamber, the real purpose of it being to prevent coal entering the tubes. Anthracite is used successfully, however, without the combustion chamber, but in the use of lignite or culm fuel, as also the fine, hard buckwheat coal, the Wootten is, I imagine, most desirable.

There is one form of the Wootten boiler, and patented, I believe, by Mr. J. Snowden Bell, in which the combustion-chamber is made in the fire-box by building a wall of brick, very much like the plan referred to by Mr. Higginson in his essay, and known as the C., B. & Q. box.

Considering the "requirement for most complete combustion," the shallow fire-box does not seem to be the best form; but it has an advantage mechanically, where, as in the case of consolidation or ten-wheel engines, it is desired to distribute the wheel base beneath the fire-box. There is now less hesitation about raising boilers above the frame than formerly, and with present practice it is possible to get a moderate depth of box even above the frames, and where practicable to use the arch, with increased length, very good results are obtained. The best form of box is, I think, an ordinary deep box fitted with some form of controllable air inlets above the fire, and with the brick arch in some of its forms, preferably supported by water pipes leading from the crown, or, as in the recent practice of Master Mechanic J. B. Barnes, of the Wabash, leading from the upper part of the back sheet of fire-box to the flue sheet beneath the arch. With these properly fitted and cared for, in connection with a suitable smoke box, it is possible to so nearly reach "perfect combustion" as to wholly prevent the emission of smoke and sparks to the atmosphere in perceptible quantity. The experience of numerous master mechanics will sustain this position.

A proper reply to your inquiry is impossible without this reference to the brick arch, as it seems an almost inseparable aid to good combustion, although of late there is reference to it as if a new subject was being considered about which there is a doubt. It may be proper to add I have used the arch for 20 odd years on various roads with all sorts of fuel used, and with satisfactory results. The saving of fuel in its use will vary with its quality, as repeated tests have shown, up to a maximum of 12 per cent., and in the case of boiler tubes of 25 to 50 per cent. of the expense may be saved. I have not noticed any injurious effects on the fire-box plates when arch is properly placed, and do not know of water so bad that the arch is not practicable, as it saves very much of the flue trouble in such cases. It does require care and labor, as also a will to use it, and I consider a device which saves many times its cost to the railroad is worth the effort to place it and retain it in use.

G. W. CUSHING.

Malleable Iron and Steel.

Editor National Car and Locomotive Builder:

In answer to some of the questions and arguments advanced by "Mechanical Expert," the writer would say, that any one familiar with the construction of the Ames coupler knows that the head or opening is very wide to admit of the working of the hook and trunnion, and that any curvature of the track threw the entire pull on one end of the trunnion, thus causing a very great wear on a comparatively small surface, not equal to half the wearing surface given to pins in the link and pin drawhead, or vertical hook couplers, and the hard iron pieces in the Ames were intended to receive that unequal fractional wear, and should they break another could be inserted without destroying the coupler's service. Even the great surface of the vertical hook knuckles is seen to show signs of wear when made from cast steel of the best known material. In tests, both in service and under drops, the better grade of malleable iron has proved its fitness for any kind of a drawhead or coupler, as the great number in service bears evidence, and no one can bring testimony of the breaking, bending or wearing out of malleable iron drawheads of established quality, unless caused by collisions or wrecks, where steel would have perished equally as quick, even at its increased cost. The eight years or more that they have been in service have not sufficed to establish the life of malleable iron draw heads of good quality, as some roads report no failures of any consequence; some even going so far as to say that none were broken, except in wrecks or collisions, where no known material could have survived the shock, and the managers of railroad companies have not as yet seen fit to substitute the more costly material of steel for one that gives satisfactory service and costs but little, if any, more than gray iron. If more malleable iron was used in car construction there would be fewer freight cars standing idle waiting for repairs, and taking into consideration the reduced weights obtained by the use and adoption of malleable iron, the longer life of service and carrying of less dead weight, no one can deny that malleable iron is the best and cheapest material for many of the parts now used in gray iron for freight cars.

It is rather amusing to read the conclusions reached by "Mechanical Expert" about the one good steel M. C. B. coupler being good for two or three malleable couplers, when no data is given for tensile strength, elongation, or chemical analysis, which is usually taken to arrive at the properties of various metals. If "Mechanical Expert" will explain to us how he arrived at the figures that malleable iron drawheads are only 24 per cent. cheaper than steel, and 65 per cent. dearer in maintenance, we might have occasion for another article in favor of malleable iron drawheads, notwithstanding his assertion that no further arguments can be made in our favor.

MALLEABLE.

Editor National Car and Locomotive Builder:

In a contribution of your June paper on the nuisance of the multitude of different patterns of freight car drawbars, I. C. incidentally makes some remarks detractory to those made of malleable iron, and has thereby caused a controversy to arise which promises to last for some time to come.

The subject is interesting and important at this particular time, when every railroad company is making preparations for the adoption of the M. C. B. type of coupler, or is at least taking it under advisement. More to keep the debate from lagging, and perhaps to induce some one better posted on the qualities of these materials to give us the benefit of his experience, than to shed any new light on the subject, I venture to send you this, and if not of sufficient interest, you will know what to do with it.

The relative value as to strength of cast-iron, malleable cast, cast-steel and wrought iron, when used for Master Car Builders' type of couplers, is to my mind about the same as the cost of their production and in the order named; the last mentioned being the strongest. Cast-iron is by all admitted as too weak and wrought iron as too difficult to forge, and consequently too expensive. Malleable and cast-steel are then practically the only materials we have to select from.

The majority of the couplers are at present of malleable, principally because they are reasonably cheap and are expected to answer the service demanded of them and not because they are the strongest possible. The cost of the couplers cannot be overlooked, as it is now the only obstacle in the way of a general adoption.

There is, however, a wide field for the manufacturers of malleable iron to operate in, if they should fail to succeed with the coupler; their material is admirably adapted for a number of parts of cars now made of cast or wrought-iron. The benefits resulting from its use in place of cast-iron is a reduction of rolling stock weight which would be equal to six per cent. of the total weight if used exclusively with the exception of wheels; secondly, a smaller per cent. of breakage due to its pliability. Its cost, however, is about the same, its higher price per pound balancing the decrease in weight.

As a substitute for wrought-iron an advantage is gained only when the required article is difficult to forge, and great strength is not necessary; instances of this kind are the anti-friction door hangers and door fastenings.

CAR-BUILDER.

Double Carding of Cars.

Editor National Car and Locomotive Builder:

The question of a number 2 or nonchargeable card for old defects has been discussed for some time, and I might say ably, the extremists going so far as to say, do away with all cards. This is no doubt owing to a misapplication of the same, making companies liable for repairs where they were in no way at fault.

In the first place, let us consider for what purpose the present M. C. B. card is intended, which is very simple, and to my understanding does not go outside of making the delivering company liable for new defects on foreign cars, and old and new on their own, that are allowed to run, owing either to load, delay, or inability to repair. If this is their purpose, and I cannot see how they can be given a wider limit, a card attached means the cost of repairs when the work is done by any company other than the one applying same, and even if card is applied to a foreign car for old defects. When we consider, on the other hand, the number of cars now in service with old defects, many of which do not materially weaken the car, and owners on their arrival would not ask any company to do the repairs, and if inclined to be fair would say this is one of our old cars that should be used for local service only. When this is the case, is not a second card necessary, or at least it would be serviceable and save many disputes and delays; it would be a clear record of the car being interchanged at a certain point, with certain old defects which possibly have existed for years, and do not interfere with its making a trip possibly with important freight. It would also show that the delivering company was willing to take the car back in same condition. This, I think, is all a receiving company could reasonable expect. Some might say; there are companies that would apply a No. 2 card for new defects; this could easily be detected by the receiving company, and should be looked out for by them. But should a case slip by and car get back to owners, the card would show a clear record, and the matter could be taken up with the company applying same. Or another objection might arise in putting on No. 2 card, when the repairs should be made. I would answer that by saying, every experienced man in the shape of foreman, inspector, etc., know a card does not add to the strength of a car, and should be applied only for defects that are perfectly safe to run. They would still have another advantage, when the car arrives home for repairs the foreman can look under the car for a No. 2 card, which is supposed to be red, and find out what repairs are needed according to an inspector's ideas.

J. C.

Contract Cars.

Editor National Car and Locomotive Builder:

Your last issue contains a communication from a "Stockholder" on the old subject of contract cars, in which he makes some very strong statements not at all complimentary to, and in fact amounting to serious charges against all persons in any way connected with the purchase of our rolling stock.

The parties interested in this are the manufacturers, the presidents of the railway companies, or more properly speaking, the officers empowered to award contracts and those whose duty it is to prepare plans and specifications and accept the cars when finished.

The manufacturer will perhaps not do more and better work or furnish better material than he has agreed to but can he do less? and if so inclined, is the railway company obliged to accept such inferior work?

All responsibility then rests with the company's officers. "Stockholder" admits that our mechanical men are perfectly competent to build good and servicable cars in their own shops, and if this is the case we can with certainty assume that they have sufficient ability to superintend those constructed in contract shops, and it is also fair to assume that they are as a rule not guilty of gross neglect of duty in this respect, with the exception perhaps of the master car builder furnishing "Stockholder" with the information that the paint on his cars was the only good point about them.

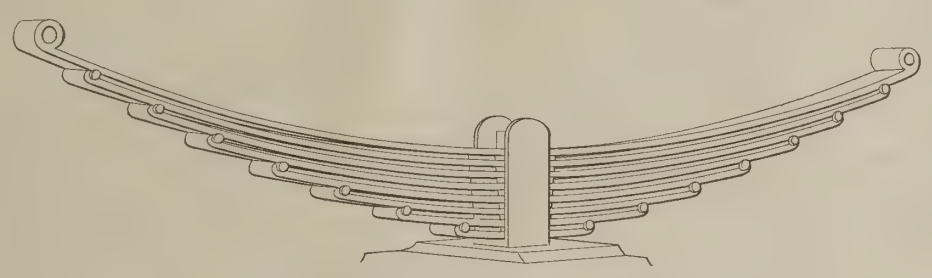
How, then, is it possible that the cost of freight car repairs is double the amount it should be, and all on

account of poorly built contract cars, unless the officers combine with the manufacturers for the purpose of robbing their companies and pocket this enormous sum? It is probable that in isolated cases the amount is unduly increased through incompetency and dishonesty in connection with the purchase of cars; but it is impossible to believe in its existence to the extent indicated or to be sufficient to materially interfere with the coveted increase of dividends.

"Stockholder's" auditor must have some very poor cars on his road indeed, if the cost to repair the average of one series exceeds that of another by more than $100 in the first four years of their existence, unless the whole lot, or large portion of it, was badly wrecked, in which case the repairs should be charged to the accident account. Less than the sum named (one-fourth of the first cost) will carry a *freight* car through the shop for general repairs, including a new roof, which it should not require for a period of at least six years. Less than one-half of this amount will keep the car in order during the first four years, unless it is wrecked. This includes worn out wheels, which are usually guaranteed for three years, and will be replaced free of charge during that period.

Can "Stockholder" devise the means by which this state of affairs he believes in can be bettered? Punishing the manufacturer after the work is delivered and accepted is too much like locking the barn door, etc.

M. C. B.



MIDELTON'S FRICTIONLESS SPRING.

Annexed engraving illustrates a frictionless bearing spring invented by Mr. Thomas Midelton, locomotive engineer of the New South Wales government railways, and used on part of the passenger rolling stock in that colony. A notice sent us with a photograph of the spring says:

The one illustrated is 6 feet long from center to center of eyes, when straight, and has been tested to carry a load of 2 tons 17 cwt. (which brought it nearly straight). The small double-headed steel rollers between the plates at each end effectually hold them in position at all times, and allow free motion without friction between plate and plate. This mode of construction entirely dispenses with the work and expense of fitting and "nibbing" each plate, as usually practiced. The buckle is merely a piece of flat bar iron shaped to fit the plates and put on cold. The cotter is driven in as tightly as may be necessary for holding the plates firmly together, and the ends are then cut off and riveted up, making the whole a neat, strong, and theoretically perfect bearing spring, which is found in practice to be equally elastic, whether loaded or unloaded. Liability to fracture is reduced, as each plate does its own work naturally and without friction.

Apprenticeship in Car Paint Shops.

The following paper was read by Mr. F. S. Ball, of the Pennsylvania Railroad, at the Cleveland meeting of the Master Car Painters' Association:

Apprenticeship in the passenger car paint shops, if not in all other shops in this country, is a thing of the past, and the question naturally presents itself, where are we to obtain recruits to supply the places of that large number of skilled workmen, who, by reason of age or other disabilities, are annually lost from the ranks of skilled labor? and why is it that the boys of this country are not taught to become skilled workmen, to supply the loss? Gen. Francis A. Walker, the head of the very successful Massachusetts Institute of Technology, in speaking on this subject of apprenticeship, is quoted as saying that "As it exists to-day it is an advantage to neither party, the apprentice can only learn a narrow specialty, so narrow, as a rule, that its only value to him is the meagre pittance which he can earn from day to day at the sacrifice of any further educational advantages." Here is an important problem for some of our labor reformers and poverty abolitionists. The solution would result in much good, for if we do not find some method by which the boys of America can become skilled workmen, we shall be compelled to get them from some country that affords boys that opportunity, and that means the filling up in time of all workshops in these United States with aliens to our laws and usages, because skilled laborers must be obtained somewhere, and if we refuse to make them, we shall have to get them from where they are made. But what has brought about this state of affairs in the industrial world and on whom rests the blame? Clearly one answer is, organized labor itself; blinded by selfishness and ignorant of its best interests, it long since issued its fiat that only a limited number of boys shall be received as apprentices in any one shop, that only a limited number of American boys shall be permitted to learn a mechanical trade, that no other means of earning a livelihood shall be open to them but that of unskilled labor. They may compete with Italians and Huns in building railroads and digging ditches, but not with skilled mechanics, and as fast as the present army of skilled labor becomes reduced by death, old age or other disability, they can stand aside and see their places filled with men of other nationalities, who have been afforded the opportunity to acquire that skill which has been denied them, thus leaving the best paid work in the hands of foreign trained workers who are too old to become thoroughly Americanized and who do not have much, if any, sympathy for our institutions. Another obstacle to the training of apprentices is the general adoption of the contract or piecework system in all large shops, which, while highly beneficial in its workings both to employer and employé, in respect to apprenticeship bars the youth of the country from acquiring a knowledge of the mechanic arts, as much so as the most ardent trades unionist could have desired. The cause is obvious, the piece worker has no time to devote to the apprentice, he has no pecuniary interest in him and cannot be expected to give of his time to his instruction, and who else is to teach him and how is he to get the knowledge and instruction. This is the problem we have to deal with. What does organized labor offer as a substitute for apprenticeship? Nothing as yet. Industrial schools supported by the state have been suggested, but can they be made to supply the place of shop training? I think it doubtful, besides the expense would fall directly upon the laborer, who would be taxed to support them, besides having the boy to support while at school learning the trade, whereas in a shop the boy is at least partly self-supporting. And just how far such schools would be serviceable it is hard to tell; while a smattering of the trade might be learned, and perhaps some specialties be acquired, such as ornamental sign writing, graining, etc., it is also true that very much of the essentially practical part could not, and, besides, such instruction would be very expensive and the work done would have no market value.

To be a skilled workman requires that one shall have served a certain time as an apprentice under the instruction of a master in the business, profession or trade, and not only that, but it requires that he be constantly employed in the practice of it otherwise he will become unskillful. Good mechanics are always in demand, and the supply is never in excess, and remunerative positions are always open to such; therefore the young man who is thoroughly proficient in all parts of his trade, both theoretically and practically, is sure of success in life, all other things being equal.

This proficiency can only be obtained in the workshop and under the apprenticeship system, which should be re-established on a sound and practical basis, making it obligatory on all who want to learn a trade that they serve a certain number of years under a master workman, being subject to him during that time in all things reasonable. At the expiration of his term of service, the apprentice should be furnished with a certificate, as evidence of his having duly served such apprenticeship.

It has been said that intelligent boys cannot be had, who are willing to be bound for three or four years to a trade, but in my experience the number anxious and willing outnumbers the opportunities, and I think the unwillingness, where it exists, is due to the practice which prevails in many shops of keeping the boys for too long a time at pot cleaning, sweeping, running errands and other drudgery, which is not a part of the trade and should furnish employment to unskilled labor. The solution of the problem rests mainly with ourselves as master painters; so far as car and locomotive work is concerned, we must be the instructors. It will entail some additional labor, but it will repay each of us in the end, by giving us workmen trained under our own eyes, in our own methods and in sympathy with our mode of working and while devoting some thought to their instruction we will advance in knowledge ourselves.

Cost of Freight Car Repairs.

Different reports of railroad commissioners have stated that the cost of car repairs is about ten per cent. of the annual operating expenses of all railroads in the United States. In a paper read at the Western Railway Club by Mr. G. W. Ettenger on Iron Car Construction, the following points were made on the cost of freight car repairs:

The Master Car-Builders' interchange rules, under which most of the railroad systems of the country make their settlements for cars destroyed, give six per cent. per annum as their basis, yet I dare say there is not a mechanical superintendent present that believes a settlement on this basis represents the value of a ten-year-old wooden car of his neighbor—in fact the figures Mr. Forsyth has given me would indicate that the life of such a car is limited to 10 years, and a car costing $500 to-day would only be worth the value of the scrap iron it might contain, less the cost of tearing down the car and handling the scrap at the end of ten years' service, or say one-half ton each of cast and wrought iron in body and four tons in trucks, about $75 at the outside, instead of the $269 bill he would be asked to approve. What it has cost the owners and operators of the car to repair and keep in order, to eke out its term of existence, is a factor of railroad mechanical management upon which accurate information is hard to acquire; but from figures in my possession, and which have been furnished me as accurate, a prominent Eastern road found the cost per annum for this branch of their service $59 per car.

The Pennsylvania has completed the electric lighting system at the large new shops at Pavonia, N. J. The night system embraces 75 lights, with 450 additional incandescent lights for the working hours when necessary.

A Busy Shop.

In the small shops belonging to the Philadelphia, Wilmington & Baltimore, close to the passenger station at Wilmington, there is more work done probably than in any place of the same size on the American continent. With 375 men they do the work for the keeping in running order of 190 locomotives, about 400 passenger cars and 3,000 freight cars, all worked to their utmost capacity. Besides doing the work of repairs in good shape, they built 9 new locomotives and 24 passenger cars last year, and a great many freight cars of different kinds. Nearly all work, old and new, is paid for by the piece, and the system is said to work very satisfactorily. The men who prosper under it have got to work steadily and skillfully, but when they do this they make better pay than any mechanics doing similar work by the day.

In the locomotive shop, they have an excellent tool room equipped with a complete set of gauges, templates and accurate small tools. They find that every labor-saving device brings in immediate returns in reduction of cost under the piece-work system. Besides several small lathes, milling machines and drill grinder, they have in this tool room a Sellers tool grinding machine which does the work usually performed on the grindstone. When this tool was put in there was at first considerable prejudice against it among the workmen; but Mr. H. D. Gordon, the master mechanic in charge, determined to use no compulsion, but let the men come for the tools prepared at the grinder as they found it to their interest to do so. For the first three months very few of the prepared tools were used, but one man after another got dropping in for them till within six months there was not a single lathe, planer or slotter man but stopped using the grindstone. One or two of the older men gave up their prejudices very reluctantly, but they were all forced to the conclusion that they could save time and make money by using the tools made ready for them and ground so accurately.

The Pittsburgh Locomotive Works are very busy at present. They are turning out about ten locomotives a month, most of them being very heavy engines. During a recent visit to the shops we saw in the erecting shop a mogul engine for the Chicago & Calumet Railroad, with cylinders 19 × 28 inches, driving-wheels 59 inches diameter, and a straight boiler 64 inches diameter at smallest ring. The total weight of the engine in working order will be about 120,000 pounds. This is the heaviest mogul engine we have ever seen. The boiler shell is made of ⅝-inch steel. They have lately delivered to the Union Pacific some engines built to the company's drawings and specifications. Among other work recently finished was eight-wheel engines for the L., St. L. & T.; ten-wheelers weighing 113,000 pounds for the St. L., A. & T. H.; and some eight-wheelers for the Vandalia Line, the latter to carry 160 pounds steam pressure.

A New Safety Switch.

General Manager G. F. Gage, of the Huntingdon & Broad Top Railroad, has invented a new automatic safety switch, which will prevent the terrible accidents that frequently happen through trains running into sidings owing to misplaced switch. One of the Gage switches has been in use for several months, and has worked so successfully that it is the intention to equip the whole road with them. The principal part of the invention is the stand, which can be applied to any form of switch, and is so devised that the switch cannot be left open to the side track. A long lever with a bell crank at the point connecting with the switch rod operates the switch, and lies horizontal when the latter is set for the main line. The weight of this lever is sufficient to throw the switch to the proper position and hold it there, but the lever is locked automatically by a V-shaped key with one arm shortened, to which it hangs on a stud. When the switch has to be opened the key is moved aside and the long lever pushed up. At the top of the guide it is held by another key, but that one will not hold unless it is kept up by the switchman, but a few ounces pressure is sufficient for this. The normal position of the switch is to the main track, and a man has to keep his hand on it all the time it is set for a siding. A gentleman familiar with the working of the switch writes to us: The fastener below is operated with the right hand, the left throwing the lever up, the right then pulling up the top fastener, which holds the main lever securely and easily against anything the engine may do when on the switch. The operator can hold the top fastener with one finger. You will observe that it cannot be locked for the side track; as soon as the operator lets go of the top fastener the lever goes down and throws the switch for main track, and is secured by a fastener below.

Objections by others: The man operating may let the fastener on top go, and let a train off of the track, going in on side track or out. We admit he may do so; we cannot provide for what men neglect to do, but for what they can do. We ask the person so objecting, which would suit him the best, to have the operator neglect to hold the fastener and let a train off going in or out of side track at four miles an hour, or let him lock the switch for side track and go away and let a fast train run through it at forty miles an hour?

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EDITORIAL ANNOUNCEMENTS.

Advertisements.—*Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING COLUMNS. *The editorial department will contain our own views and opinions; and the rest of the reading matter, aside from advertisements, will be such as we consider of interest to our readers.*

Contributions.—*Articles relating to railway rolling stock construction and management, and kindred topics, by those who are practically acquainted with these subjects, are especially desired. Also early notices of changes in railroad officers, organizations and names of companies.*

Special Notice.—*As the* CAR AND LOCOMOTIVE BUILDER *is printed and ready for mailing on the last day of the month, advertisements, correspondence, etc., intended for insertion, must be received not later than the 25th day of each month.*

Useless Diversity of Railroad Machinery.

Intelligent men whose business leads them to visit the mechanical establishments belonging to the railroads all over this continent often have reason to marvel at the incomprehensible practices and products of prejudice which they encounter on all hands. A British contemporary lately put before its readers questions about diversity of locomotive practice which indicated that the locomotive designers across the Atlantic were influenced more strongly by personal crotchets in the building of their motive power than by an enlightened judgment respecting what form was best adapted for the work to be done and the physical character of the road where the service was performed. Such questions as the following were asked: "Why have express locomotives on some lines inside cylinders, while on others the cylinders are outside? Why do some express locomotives have coupled wheels, while others, pulling as heavy trains, have a single pair of drivers? Why do some engines have domes, while others take steam from a perforated dry pipe? Why does the heating surface for certain size of cylinders vary from 1,000 to 1,500 square feet? Why do some passenger engines have bogies and others have the front carried on a single pair of wheels?" etc., etc. Most of these queries do not apply as criticisms of our locomotive practice; but there are many others which might be asked that would illustrate the diversity found in the construction of our railway machinery, and for which it would be impossible to find a more rational answer than—many men, many minds.

If radical difference in practice made no difference in the expense of operating, onlookers and those financially interested might be contented to regard the preferences of different men with calm amusement or curiosity, but it nearly always happens in diversities of design that there is a right and a wrong, and the choosing of the wrong implies that increased expense is incurred in obtaining required results. When this is the case the error of judgment or, what is oftener the case, servility to a crotchet, which leads to a faulty design or to the choice of unsuitable material, becomes the object of legitimate criticism. We have heard such questions asked as why some master mechanics prefer straight boilers or forms that provide limited steam room, when the wagon top boiler is the recognized type of the American Railway Master Mechanics' Association? Some critics ask, is there any necessity for making expensive butt joints for boiler seams when lap joints have been found perfectly reliable? Why do some designers secure the crown sheet by means of radial stay bolts when others use crown bars? Why are the locomotives for some roads built with the mud ring above the frame, while the common practice is still to make a deep narrow fire-box? Is there good reason for the fact that on some roads a brick arch is a recognized feature of every fire-box, while on other roads using the same kind of coal and doing similar work, no brick arch is used? Why is it that on some roads the belief prevails that the extension smoke-box and open stack are conducive to the economy of fuel, besides preventing fire-raising, while on other roads, with no material difference in surroundings, a short smoke-box and open stack are declared the best method of arresting sparks; and on yet a third set of roads the diamond stack, petticoat pipe and other old combinations are used and declared to be perfectly satisfactory? Common practice makes the length of the cylinder steam ports about the length of the diameter of the cylinder then why is it that some designers make their ports 25 per cent. or more shorter? Why do some men use balanced valves and others cling to the plain slide valves? Why are the valves operated by a long eccentric throw on some roads, and by a short throw on others? Why do some roads use nothing but injectors for feeding the boilers, while others keep to the pump? Is there a rational explanation why some master mechanics say they save fuel by using a feed-water heater, while others say that heaters do not pay the cost of maintenance? How do some roads successfully use cast-iron guides, cross-heads, piston-heads, rocker arms, etc., while others allege that nothing weaker than steel is admissible for these parts? Why do some men prefer steel for axles, crank-pins, side-rods, piston-rods, etc., while others insist that nothing but good hammered iron is safe for these parts?

The list of such questions might easily be greatly prolonged, and every man familiar with railroad motive power can readily add new ones for himself. In some instances it is exceedingly difficult to arrive at a satisfactory estimate of the relative value of two methods or forms; but in most of the cases cited, there ought to be no great difficulty about settling on which was the best. If there were more careful carrying out of tests and experimenting by competent experts, and a greater disposition to yield to the teaching of experiment instead of holding on blindly to a method or form because it was old, there would be more hope of rapid progress in the reduction of operating expenses. Some master mechanics experiment presumably to find out the best forms, material and methods, and appear to interest themselves in what others are doing in the same direction, but yet fail utterly to permit their ordinary practice to be influenced by the plain teachings of the experiments they have watched. Other men publicly discuss lines of improvement and are ready to suggest to others the adoption of forms and methods by which saving of expense is likely to be effected, yet they go home and continue to run their own business in the deepest kind of rut without showing the least disposition to reduce their preaching to practice. The tendency of the trained intelligence and cultivated thought among designers is towards uniformity, but while the practices mentioned continue to be common, our railroad machinery is likely to keep falling into a hopeless chaos of diverse forms.

Form of Wheel Flange and Rail Head.

Most of our readers will remember that in 1883 a committee of the Master Car Builders' Association, of which Mr. H. S. Goodwin was chairman, submitted a report where it was stated that they were strongly of the opinion that by far the greatest cause of sharp flanges was the sharp corners of the rails, and they recommended that the rail head should be rounded off to fit the fillet of the wheel flange. A year later Mr. M. N. Forney submitted to the Association a long and elaborately illustrated paper on the "Relation of Railroad Wheels and Rails to Each Other," in which he supported the theory that the principal part of flange cutting was due to the sharp corner of the rail. Officers in charge of permanent way were strongly urged to change the form of the rail head so that the corner should be a curve of ½ inch radius. It was argued that a change of this kind would materially increase the surfaces of rail and wheel that came in contact, and that, consequently, following a well-known law of mechanics, the resistance to wear would be increased. The subject was very freely discussed in the Master Car Builders' conventions and in the technical journals, the drift of opinion being against the sharp cornered rail. Conforming to this sentiment several of the leading railroad companies changed the form of their standard rail head, giving it a round corner, making it correspond to the shape of the wheel.

Shortly after the reading of the paper mentioned, the subject was introduced into the American Society of Civil Engineers, and a committee consisting of H. S. Goodwin, A. M. Wellington, Samuel Rea, George S. Morrison, Thomas Rodd, James Archibald and S. M. Felton was appointed to investigate "The Proper Relation to each other of the Sections of Railway Wheels and Rails." A preliminary report of this committee has lately been published, and it contains much information that is interesting and instructive. The work of the committee has been very thoroughly and exhaustively performed so far as it has gone, and the conclusions to be drawn from the report indicate that abstract reasoning applied to the causes of flange wear is liable to lead the brightest of men into serious error. It is clearly shown that the arguments in favor of round cornered rails were based on mistakes, and that the percentage of sharp flanges increased very materially on the roads where round cornered rails had been adopted as standard to take the place of rails having a corner of short radius. Recorded observations of wear of rails as modified by flange contact, went to prove that rails wear much faster after the corner becomes rounded on curves or elsewhere than they do when the corner is comparatively sharp, and as action and reaction are equal, the wear of the wheel flanges that grind down the rail must increase in proportion to the increase of bearing surface. While the corner of a rail section remains sharp the contact between it and the flange fillet is very small, and the wheel rolls along holding to the rail by rolling friction. When the rail head is made by wear or design to fit the fillet of the wheel, the surfaces in contact produce partly rolling and partly sliding friction. The latter will induce rapid wear, and the tendency of rail head and fillet fitting each other will be to greatly increase the flange wear instead of reducing it. The old Pennsylvania standard rail had a corner made to a radius of $\frac{5}{16}$ inch, and the new rail corner is made $\frac{1}{8}$ inch radius. The committee examined these two rails on parallel tangents where the old rail had been down eleven years and the new rail one year. The old pattern has a corner sharper than it was when new, and the round-cornered pattern was badly flange-worn. Similar results were noted on other roads where the two forms of rails are in use. These and other observations indicated that the rail wore much more rapidly as the rubbing surface was increased, hence it is safe to infer that the wear of the wheel increased in a like ratio. So it is reasoned that it is better to make the fillet of a wheel flange to a long than a short radius, for it will give a longer period of wear before the flange comes into the contact which produces rubbing of the surfaces.

Effect of a Small Exhaust Pipe.

What is one man's nourishment is another man's poison, is a proverb that has many practical illustrations in railroad life. To one man an invention comes as a boon to help in reducing the expenses of his department, while to another man similarly situated the appliance, after what seems to have been a fair trial, proves entirely worthless. It is often difficult to find out how intelligent men, zealous to promote the interests of the companies they serve, come to conclusions so conflicting about things which ought to give the same results in different hands. We recently had the opportunity of observing experiments by two different master mechanics with substantially the same device, and their conclusions were so far apart that the particulars of the case may be edifying to others who fail to obtain expected results out of apparently improved appliances.

Master Mechanic A had been induced to put the extension smoke-box on a number of his engines, but influenced by an old prejudice, he used double nozzles with a high exhaust pipe. He was satisfied that his new arrangement for spark arresting was better than the short smoke-box and petticoat pipe, but still the arrangement was not entirely satisfactory. The nozzles necessary for making steam were rather small, and the sharp exhaust pulled so many sparks into the smoke-box that emptying them was a troublesome addition to the fireman's work, and complaints were made accordingly. In talking the matter over with another master mechanic, he was advised to try a single nozzle, and having about the same time read an article in a railroad journal strongly favoring the single nozzle, he determined to put himself in the line of progress by trying it. The exhaust pipe used had two branches leading the opening of the exhaust passages from the saddle up to the level where the nozzle tips were secured. It formed two parallel pipes in one casting, and each pipe tapered from the opening in the saddle casting down to the size needed for the nozzle. The master mechanic told the pattern maker to take this exhaust pipe and run the upper parts of the parallel pipes together till they ended in one opening, into which a single nozzle was placed. The change was made first on one engine to which nothing else was done. When the engineer took the engine out after the change, he complained that she would not run. The engine had been pulling a fast train, and investigation proved to the satisfaction of all concerned, that after getting on the single nozzle she could not be pushed to make running time. The result was, that the single experiment ended the use of a single nozzle on that road, and double nozzles are now employed on all engines with high or low exhaust pipes.

The first portion of the experience of Master Mechanic B was in all respects similar to that which led A to abandon the single nozzle. He used an exhaust pipe with passages about the same size as those through the saddle, and when these were made to terminate in a single nozzle, and the engine was put to work running a fast train, the engineer complained that she could not be forced into the speed necessary for making time. The master mechanic suspected that prejudice had something to do with keeping the engine from making time, and he went out and tried her himself, but a very short experience in the cab convinced him that the free running capacity had been taken away from the machine. This did not, however, convince him that the single nozzle was not the proper opening for a high exhaust pipe, it only proved that for some reason the steam was not passing freely away from the cylinders, although the nozzle was large and made a soft exhaust sound and made the necessary steam with very mild action on the fire. He had a new pattern of exhaust pipe made about double the size of the old one and put it on. The same size of single nozzle was used, but the difference in the working of the engine was so pronounced that the engineer says there is no limit of the speed she can make. Master Mechanic B is looking for some one to give a full and satisfactory explanation of why enlarging the exhaust pipe made such a difference, when the old pipe had a passage as large as the saddle opening. He has not heard the

explanation yet, but all his engines having extension smoke-boxes have single nozzles and all concerned are convinced that the arrangement saves an important percentage of coal.

Mileage of Wheels Removed for Sharp Flanges.

While investigating the proper form of rail sections in relation to wheel treads, a committee of the American Society of Civil Engineers discovered and demonstrated several interesting facts relating to the wear of wheels. Statistics of the wheels removed for all causes on the railroads keeping the most trustworthy records were collected, and they indicated beyond question that where the wheels are of fair quality the average mileage of wheels removed for sharp flanges is very decidedly above the average life of all wheels, and is even, with one exception, the highest among the various causes for removal of wheels worn out by legitimate wear. As the quality of the wheel falls below the average, the statistics collected show that the percentage of sharp flanges very rapidly increases. After directing attention to the tables of statistics of wheels removed for various causes on the Pennsylvania Railroad, the report of the committee referred to continues: "The mileage of wheels with 'worn flange' is very remarkably above the average of other wheels which fail from wear, and is even appreciably higher than the average of two select classes of choice wheels which fail from old age. This class of wheels constitute only a very small percentage of the total drawn from service (2½ to 3 per cent.), just as old age constitutes a very rare cause of death among human beings, and for precisely the same reasons. It requires an entire absence of specific defects of structure."

"An alleged disease among human beings which showed a somewhat higher average age at death than the average of deaths from old age, would not ordinarily be regarded as a very serious matter, nor would there be any great anxiety to decrease the number of those who died by it; and it is a highly significant and important fact that in this most complete record available, the wheels which show the very highest mileage practically, are those which have been drawn at last because they were suffering from a disease which it has been supposed was so important to cure—worn flange."

"This is especially remarkable, if we consider further, that there is much less metal to wear away to make a wheel sharp-flanged, than to make it hollow tread; that a hollow tread has a much greater bearing surface than one that is running to flange, which should reduce the rate of abrasion if the greater bearing surface is a gain, and chiefly that inspection will naturally be much sharper and removal quicker with sharp flanged than with worn tread wheels, the latter being in no sense a dangerous defect."

Commenting on the tables quoted to prove the long mileage obtained from wheels before they are removed for flange wear, the committee say that they can see no escape from the conclusion that in spite of the less bearing surface, the less material to wear away to condemn, and the closer inspection, wheels which are wearing sharp at flange make, if anything, a larger mileage than any other class of wheels, and certainly show no appreciably less mileage under normal conditions. This rather surprising conclusion, which was unexpected to every member of the committee, necessarily implies that the rate of abrasion of metal from wheels which are wearing sharp at flange must be materially less in pounds per thousand miles than in wheels which are wearing hollow in tread, because there is a smaller amount of metal to wear away to have the wheels unserviceable.

Pea Coal for Elevated Railroad Locomotives.

The locomotives used on the elevated railroads of New York have always burned a good quality of egg anthracite coal, and the small engines have never had much margin of steaming capacity for the heavy work they are required to do. Knowing this from intimate acquaintance with the performance of the engines, we were very much surprised lately to hear that it was the intention of the officers of the road to begin burning pea coal in the fire-boxes of the engines. A single engine was tried first, and with a great deal of favoring she was kept running, and this very meager measure of success was deemed sufficient excuse for supplying that kind of fuel to a dozen or more of the engines as a preliminary to putting the whole equipment on pea coal. But the experiment on a large scale, which put each engine on her own merits, soon demonstrated what burning fine coal in small fire-boxes really meant. For the day it was tried, the train service on the Third avenue line was very seriously crippled. The engines lost time so badly for want of steam, that intervals as long as thirty minutes occurred between trains; which entailed a vast amount of inconvenience upon the people of New York city who are dependent upon these roads for prompt and regular transit.

Any one who is at all familiar with the combustion of anthracite coal, and has reflected on the conditions necessary to its use, must have been aware that it could not be successfully burned on the limited grate area found in the elevated railroad locomotives. We do not believe that there is a single locomotive in the country burning pea coal, pulling passenger trains that stop and start frequently, even in fire-boxes like the Wootten that are specially designed for small coal, and it was pure insanity to pretend that it could be done in small fire-boxes of engines doing the hard work performed by the locomotives on the elevated railroads. Slack coal entails slow combustion per foot of grate area and the use of a thin fire. Frequent starting from stations is fatal to the use of a thin fire, for the strong exhaust tears holes in the fire, consequently service like what has to be performed on the elevated railroads is the least adapted for the use of inferior fuel. Considerations of this kind ought to prevent the officers of any railroad operating trains that stop frequently from trying experiments with fine coal, and the elevated railroads of New York ought to be the last to try anything of the kind, for when everything is done to favor the engines there is too small margin for bad weather and the numerous other exigencies that are ever arising to impair the regularity of trains. Moreover, the Elevated Railroad Company of New York have no right to try experiments which are calculated to derange the regularity of trains, causing delay to the public and incurring unusual risks of accident. At some times of the day the train service is very much behind the demands for accommodation, and the attempt to save a few dollars at the expense of making intolerable blanks between trains, is simply trifling with the needs and rights of a vast multitude of people.

Overhead Heating of Shops.

At the last meeting of the New England Railroad Club, Mr. Albert Griggs, Superintendent of Machinery, of the Providence & Worcester, related the experience he had gone through with shops heated by what is known as the over-head plan, which ought to receive attention from the officers in charge of shops. The over-head plan of heating shops has been urged upon railroad men very zealously for the last few years. When the pipes and radiators are located along the sides of shops close to the floor or under work-benches, they are liable to receive damage from heavy articles being thrown against them, and when greasy waste and other inflammable substances collect about the pipes, fires are often started that lead to the destruction of the buildings. Parties seeing these serious objections to the means of heating being placed where they are usually to be found, advocated the locating of the pipes overhead or far enough up on the walls to be away from the risk of damage from moving material, and of course away from all accumulation of inflammable litter. This plan was said to work well in factories where it was first tried. We can see no reason why it should not be made successful if sufficient heating surface be provided, but there must certainly be a great waste of heat in buildings where openings are made above for the escape of vitiated gases, as is the case in all railroad shops. Mr. Griggs found that although they passed steam through the pipes till the planks of the roof were warped and the slates broke off, the temperature in the working level could not be raised sufficiently to enable the workmen to operate with comfort with their coats off. A system of heating which maintains the shop so cold that the workmen must muffle themselves up to keep from freezing cannot be regarded as a burning success, even if it prevents the starting of accidental fires. If there are any railroad shops using the overhead system of heating successfully, we should like to hear particulars of the proportion of heating surface provided to the cubical content of the buildings.

William R. Davenport.

On December 13, Mr. W. R. Davenport, president of the Erie Car Works, died very suddenly while in Buffalo on a business visit. Mr. Davenport was one of the most popular and best known car-builders in the country, and his loss will be mourned by a large circle of friends, for he was a man with very attractive qualities. Although he was not a practical mechanic, few men connected with car building were so thoroughly master of all details of the business. His voice and influence were ever zealous in promoting the use of proper material and honest work, and the practice of his life as a builder of cars fully vindicated his publicly expressed precepts. He was an eminently progressive and far seeing man, and no speaker at the Car-Builders' conventions was listened to with greater attention. His presence, his council and his vigorous, earnest talks, will be sadly missed at these meetings.

Mr. Davenport began his working life as a clerk in a store, and he afterwards entered the service of the Cleveland, Painesville & Ashtabula Railroad as a clerk in the depot at Erie. He subsequently rose to be superintendent of the road, and left the service of the company to enter into partnership with another gentleman to begin the manufacture of car-wheels. The firm then formed, after several changes, developed into the present Erie Car Works. Mr. Davenport was instrumental in originating several other industries that have prospered and brought great benefit to Erie and other cities. He was an occasional contributor to the pages of the NATIONAL CAR AND LOCOMOTIVE BUILDER, on subjects connected with his business, and few readers took a warmer interest in the topics discussed in our columns. At his death he was 57 years old. Few men leave a cleaner name with a sorrowing family; and few lead a life that so well prepares them for a sudden call hence.

Towards the end of November, there was a butting collision near Colorado Springs on the Denver and Rio Grande with a passenger train belonging to the road named and one belonging to the Chicago, Rock Island & Pacific. The accident was caused by a mistake in the delivery of train orders. Both trains were running at a high rate of speed when they came together, and a bad smash occurred. The cars of the Denver & Rio Grande train were heated with stoves, and several of them took fire and were burned up. Fortunately the inmates of the cars had time to escape, and no lives were lost. This is the second or third case already reported this season, where passenger cars were burned up in accidents, the deadly stove starting the conflagration. The application of safe methods of heating to railroad cars is going on slowly and steadily, but the number of passenger cars that are free from the danger of being burned up is still painfully small. Every day more clearly demonstrates the advantage of heating the cars in a train by steam or hot water, and the traveling public are becoming educated to regard that as the proper method of heating. The railroad managers who persistently refuse to adopt any thing better than the ancient stove are not only clinging to the dearest way of heating their cars, but they are braving public opinion on a question that the public have had good reason to feel very strongly about. If a bad holocaust started by the car stove should happen, as it is liable to do any day on the Pennsylvania system, for instance, where the stove still reigns unmoved, it is likely that the courts would deal in no tender manner with the managers who must be held responsible for the retention of a system admitted on all hands to be dangerous.

The persons interested in the Daft electric motor made some experiments last month in handling trains on the Elevated railroads of New York. The motor weighs 9 tons, and the feat which its owners are trying to perform is the pulling of the trains that make a full load for locomotives weighing 23 tons. We have no doubt but electric motors can be made to handle the trains on the elevated railroads of New York; but they must be made heavy enough to develop the tractive force required of steam locomotives. In the trials referred to, the motor handled four empty cars in about the same way that a small locomotive having 9 tons weight on the drivers would do. Putting a small electric motor to pull a load admittedly beyond its capacity is trifling with an interesting mechanical problem. To pretend that an electric motor will by some occult means develop more adhesion than what is due to the weight resting on the wheels, has a tendency to make intelligent people conclude that there are pretentious charlatans running the electric motor business.

A railroad club has been formed at St. Paul, Minn., and we feel certain that the men who help to carry it on, and the railroads they belong to, will be materially benefited by the information gained by attending the meetings. In the account of the preliminary meeting called to form the club it might be noticed that the chief mechanical officers of one or two of the neighboring roads with headquarters in one of the Twin cities were conspicuous by their absence. Keeping away from meetings of this kind is short sighted policy and it is a sure sign that the parties concerned are not anxious to keep abreast of current progress in railroad machinery matters. The same thing is to found in other places where railroad clubs meet, and with few exceptions the men who keep aloof from the clubs run their departments in a manner that is no credit to themselves or the roads they are connected with.

To be prepared against a possible recurrence of the snow blizzard of March last, the Philadelphia & Reading have gone to great expense in constructing an immense snow plow of the old board bucking type, and they have been so well pleased with the appearance of the vehicle that the company have ordered twenty-five more of them to be built. A plow of this kind is about as useless as an elephant would be in a heavy snow blockade with ice in the rail flanges. The New York Central have shown much more mechanical acumen in their desire to be prepared for heavy snow. They have purchased a rotary steam snow shovel, the machine that handles snow in a mechanical fashion worthy of this year of grace.

We have been informed by one of the officers of the New York, New Haven & Hartford that they were not the designers of the heavy passenger engines which we criticised last month. He also says that after the making of a few minor changes and adjustments the engines have done very good service on the heavy fast passenger service for which they were designed.

Personal.

Mr. B. L. Babb, late car accountant on the Nypano, has been appointed superintendent of car service on the Mexican National.

Mr. Charles P. Coleman has been appointed chemist for the Lehigh Valley Railroad Company, with headquarters at South Bethlehem, Pa.

Mr. George Ross has resigned his position as master mechanic of the Montana Union road owing to a strike of the engineers and firemen on that road.

Mr. E. McNeil, who was some time ago offered the general management of the St. Joseph & Grand Island road, has accepted that position.

Josiah Johnson, who was formerly superintendent of the Western Division of the Southern Pacific, and also of the Placerville Division of the same road, died recently at Sacramento.

Mr. D. J. Durrell, for some years master mechanic of the Union Pacific, has accepted the position of mechanical engineer of the Rotary Steam Snow Shovel Mfg. Company, Paterson, N. J.

Norman Beckley, general manager of the Cincinnati, Wabash & Michigan, contemplates retiring, on account of poor health. He has held his present position for ten years, coming off the Lake Shore & Michigan Southern, on which he was for many years a division superintendent. He entered railway service in 1845, on the Vermont Central.

President Samuel Thomas, of the East Tennessee, Virginia & Georgia, has repeatedly tendered his resignation as president to the directors, but it has each time been declined. The directors appointed a committee to try and persuade General Thomas to withdraw his resignation, and he finally consented.

Mr. D. D. Arden, has resigned his position as master mechanic of the Central of Georgia. He had been on that road for thirty-six years, having served his apprenticeship to the machinist trade in one of the shops. He ran on the road as engineer for twelve years and rose by successive steps to the position he lately occupied.

Mr. J. T. Harahan, who has left the Louisville & Nashville to accept the position of assistant general manager of the Lake Shore & Michigan Southern, has been one of the most successful and popular of Southern railroad officers. He rose from the ranks in a Southern road and was successively engineer, conductor, roadmaster and superintendent. What there is about practical railroading which Mr. Harahan does not know is hard to find out.

Mr. Waterman Stone, of Providence, R. I., the well-known secretary of the North American Superintendents Association, has resigned his position on the Old Colony to become general manager of the Inter-state Consolidated Rapid Transit Railway of Kansas City. Mr. Stone, although a young man, has been in the service of the Providence, Warren & Bristol for 24 years, and has worked in all departments. For 17 years he has been superintendent and chief engineer.

Mr. D. A. Stewart, president of the Pittsburgh Locomotive Works, died very suddenly at his home in Pittsburgh, on Dec. 14. Mr. Stewart was the son of an officer of the Pennsylvania Railroad, and he began work in one of the offices of the same company. He formed close relations with Mr. Thomas A. Scott, and to that gentleman's good offices much of his success was due. Of late years he has been closely associated with Carnegie Brothers & Co., and at his death was chairman of that firm.

Mr. J. E. Phelan, who was last month promoted to the position of master mechanic of a part of the Northern Pacific, has for several years performed highly important services as general road foreman of engines. Besides being a very successful engineer and mechanic, Mr. Phelan is a very interesting writer on railroad mechanical subjects. Several articles from his pen have appeared in the NATIONAL CAR AND LOCOMOTIVE BUILDER, and he is at present contributing to the *Locomotive Engineer* a series of articles on "air brakes."

Thomas F. Oakes, president of the Northern Pacific Railroad, is here in connection with the affairs of the company. His headquarters are at St. Paul, and he spends much time on the line to keep himself thoroughly informed of the state of the road and its business. He is a practical and consequently a successful railroad man. He was vice-president and general manager during the presidency of Henry Villard, who is once more in financial control. Mr. Oakes is a well-built, middle-aged man, with a full brown beard and a genial though shrewd face. He dresses very carefully, though not ostentatiously. He has a reputation as an after-dinner speaker that was earned in desperate conflict over wine and viands. Mr. Oakes smokes, like most men who have to use their heads in the direction of great enterprises.—*N. Y. World.*

R. M. Richardson, master mechanic of the St. Louis, Iron Mountain & Southern. has resigned, and has been succeeded by Frank Readon, of Denison, Tex., who has been with the Missouri, Kansas & Texas for several years, as master mechanic. Mr. Richardson has been in the service of the St. Louis, Iron Mountain & Southern since 1866. The position he now resigns he has held for 14 years. It is reported that after a vacation he will accept another position on the system.

Literary Notes.

RELATION OF RAILROADS TO FOREST SUPPLIES AND FORESTRY, together with Appendices on the Structure of some Timber Ties, their Behavior, and the Cause of their Decay, etc.

This report, issued by the United States Department of Agriculture, was prepared by Mr. B. E. Fernow, chief of the Forestry Division, and consists principally of papers written by experts on subjects that have a direct bearing on the preservation of our forests. The development of the railroad system in the United States is outlined, and figures, that evidently represent careful study, are given showing the enormous drain which the building and maintenance of our railroads have made upon the forest resources of the Continent. The effects on the existing supply of lumber, of the growing demands raised by the steady increase of railroad mileage, are intelligently discussed, and partial remedies for the coming scarcity are suggested. A careful perusal of the report will convince most of readers that a timber famine is approaching unless the proper means are resorted to to increase the natural supply or to stem the growth of the demand. The principal preventives recommended are tree culture and precautions against forest fires, the adoption of processes that will preserve timber while in use, and prolong the period of its service, and the substitution of iron and steel as a material for ties and other members of a railroad structure which are subject to the influences that cause rapid decay.

There is a very interesting and profusely illustrated article by Prof. P. H. Dudley on "Structure of certain timber-ties, behaviors and causes of their decay in the road-bed, together with experiments on the adhesion of spikes," which all railroad officers ought to study. Papers are published in the report by J. N. Lauder, of the Old Colony, and George W. Tilton, of the Chicago & Northwestern, on "Spark arresters."

DAYLIGHT LAND.—The Experiences, Incidents, and Adventures, Humorous and Otherwise, which befell Judge John Doe, Tourist, of San Francisco; Mr. Cephas Pepperell, Capitalist, of Boston; Colonel Goffe, the Man from New Hampshire, and divers others, in their Parlor Car Excursion over Prairie and Mountain; as recorded and set forth by W. H. H. Murray. Cupples and Hurd, Publishers, Boston, Mass.

This is a highly interesting book. The scenes portrayed are in the northwestern side of this country, which is little known to the average reader and has lately become within easy reach of travel by the Canadian Pacific Railway. The great region, with its delightful variety of scenery, its game, and its vast material and undeveloped resources supplies the author with a subject which has not been trenched upon even by the magazines, and which he has treated in that lively and spirited manner for which he is especially gifted. The result is a volume full of novel information of the country, humorous and pathetic incidents, vivid descriptions of its magnificent scenery, shrewd forecasts of its future wealth and greatness when developed, illustrated and embellished with such lavishness and artistic elegance as has never before been attempted in any similar work in this country.

SCRIBNER'S MAGAZINE for January contains an interesting article on railroad management, by Mr. E. P. Alexander. The author outlines the organization that constitutes the executive departments of a railroad company, and gives some particulars of the duties performed by the heads of the various departments. The work done in several of the departments is entered into at considerable length. The various methods of clearing away snow obstructions are detailed and illustrated, the rotary steam snow shovel at work having a prominent place. Methods of signaling, train dispatching and the handling of traffic are discussed in a readable way; and a few of the trials, tribulations and frauds to which railroad companies are subjected are made public. The article is well worth reading.

BOILER CATECHISM. By Robert Grimshaw. Size, 4 × 6 inches. 402 pages. Published by the Practical Publishing Co. Price, $2.00.

This book is intended for men in charge of boilers, and a great deal of valuable information is given in a simple and elementary style. The author does not pretend to peak to experts, but offers the learner and the inexperienced an easy source of reference, which is absolutely accurate on the questions treated.

An illustrated supplement is issued with a recent number of the *Metal Worker* giving plans of a house, and the proprietors of the paper offer a prize of $300 for the best practical essay on the heating of the building. The medium for heating to be recommended may be a hot air furnace, steam circulation or hot water circulation.

The Union Palace Sleeping Car Company are getting 40 new cars of the Mann Boudoir pattern built at Wilmington.

Car building is done very extensively in the shops belonging to the Pennsylvania Railroad by piece work. The prices paid the men for putting the cars together varies from 20 to 25 dollars for stock cars and about 30 dollars for box cars. From 4 to 5 dollars is the price paid for painting a car.

The Eastern Railway of Minnesota has lately received some eight-wheel passenger engines, part of an order of eighteen, from the Rogers Locomotive Works. The cylinders are 18 × 24, and the drivers 63 inches diameter. The engines have Krupp steel driving-wheel tires, Boies steel-tired wheels under engine truck and tender. The equipment includes Westinghouse air brake, Nathan sight-feed lubricators and Monitor injector on one side, and Friedmann non-lifting on the other, both being on the right hand side of the cab. The Rogers Locomotive Works have also during last month shipped a standard passenger locomotive to Cuba; also one to Nova Scotia. They have about ready for shipment two for the Nashville, Chattanooga & St. Louis. These latter are equipped with the Luttgens variable exhaust damper.

Mr. H. A. Luttgens, Paterson, N. J., has published an illustrated pamphlet showing the well-known variable exhaust damper, and stating the advantages of using the device. Several testimonials are given that present striking evidence of the fuel-saving merits of the damper. Copies of the pamphlet can be obtained on application to Mr. Luttgens.

The Cowles Electric Smelting and Aluminum Company, Lock port, New York, have published a small pamphlet giving information about the production of their works. It contains particulars about the working qualities and uses of aluminum alloys, tables of tests, a list of articles that have appeared in the technical journals relating to aluminum, and other interesting information.

Messrs. Byram & Co., Detroit, Mich., exclusive manufacturers of the "Colliau" Cupola Furnace, have recently placed four of their large size "Colliau" cupolas in the new shops of The United States Rolling Stock Company, at Anniston, Ala., and besides other orders have a contract with The C. A. Treat Car Wheel Works, now locating plant at East Chicago, for two large size "Colliau" cupolas.

The Page Belting Company, of Concord, N. H., have established a store at No. 17 Federal street, Boston, under the management of Mr. J. P. Jewell, where they will keep a full line of their goods for New England trade. Their business for October, 1888, was 30 per cent. more than for the same month last year. They will keep also a full line of the Gutta Percha & Rubber Manufacturing Company's goods of New York City.

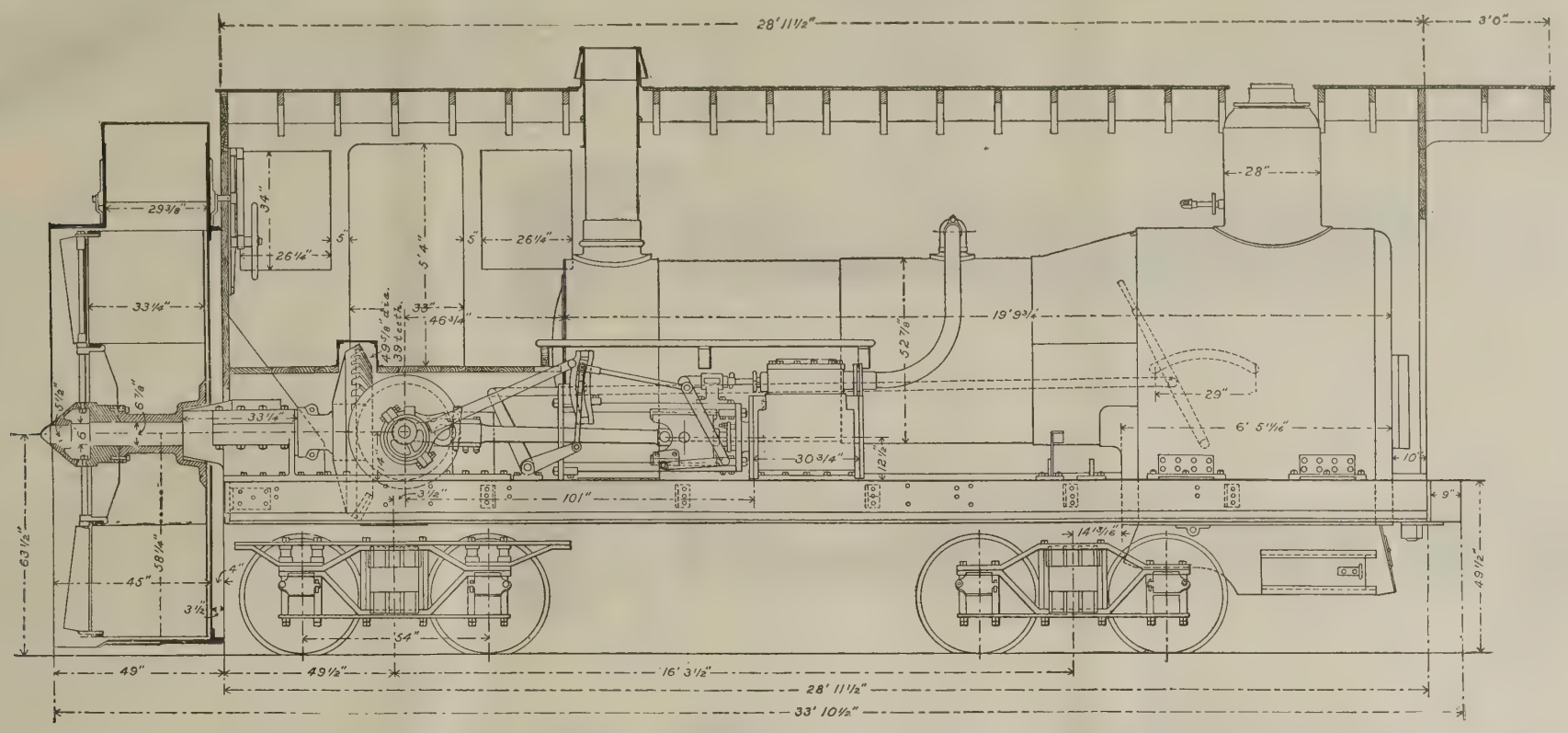
We have received from Williams & Brown, Philadelphia, a blue print made on a material they manufacture specially for the purpose. It is called "Linaura," and is a fine linen fabric, tough and strong, that takes the imprint as clearly and cleanly as the best prepared paper. The advantages of making blue prints on material that will stand a good deal of rough handling without receiving injury are obvious to every person who has had anything to do with machine shop work. The material has even greater merits for the making of blue prints that have to be used in the open air as in engineering work. Linaura will doubtless come rapidly into favor as its advantages become recognized.

The Emmert coach and reclining car seats made by the Johnston Car Seat Company, Chicago, are meeting with great favor among railroad men. The seat has been only a short time on the market, yet it is already in use on a great many roads. Among the roads using it are the Chicago, Rock Island, & Pacific; Chicago, Burlington & Quincy; Wabash & St. Louis; Wabash & Western; Kansas City, Fort Scott & Gulf; Chicago & West Michigan; Grand Rapids & Indiana; Chicago & Alton, and the Northern Pacific. The same company have now ready for use the new Hartley revolving and reclining chair. This seat saves four inches of aisle room and has fewer parts than any other revolving chair.

During a visit recently paid to the works of the National Lock Washer Company at Newark, N. J., we found them turning out very large quantities of the washer that forms the nut lock. The device is extremely simple, consisting of a cut washer formed with a pitch which brings the back edge of one side flush with the front of the other side and forms a spring which constantly keeps the nut in tension. On the inside of the washer which embraces the nut there is a thin rib all round. When the nut is screwed up this rib presses upon the thread of the nut and tends to squeeze it and the thread on the bolt into close contact. It is well-known that when the threads in nut and bolt are an absolutely true fit, there is no danger of the nut working off, and this washer appears to produce this desirable result.

The material used for making the washers is fine steel hardened in oil, with the temper drawn by a process used in the manufacture of small springs.

The washers are used largely for track work, but they are coming rapidly into favor for car building purposes, for which they are very well adapted. No jam nut is necessary where they are used. We believe they would prove very satisfactory about any part of a car or locomotive where there is difficulty experienced in getting nuts to hold in their places. The washer is simpler and cheaper than a jam nut, and is said to be much more reliable. The company are about introducing a washer lately patented for fastening nuts or small bolts used on wood or metal work which makes a very secure job.



THE LESLIE ROTARY SNOW SHOVEL.

The accompanying illustration represents the latest form of the Leslie rotary snow shovel, as now constructed by the Cooke Locomotive Works, of Paterson, N. J., for the approaching season. Sixteen of these rotary shovels are now building, including three for narrow gauge roads. It is expected they will all be finished in time for the first heavy snow fall. Some alterations and improvements have been introduced, but the general principle of the shovel remains unaltered, as shown in previous illustrations.

The general construction of the rotary is well known to the majority of our readers, but a brief description may be useful.

A stout frame of heavy I-beams is mounted upon two four-wheeled diamond trucks, the whole construction being of extra strength. This frame carries a large locomotive type boiler with a fire-box which extends the full width between the wheels, as shown in the rear elevation. This boiler supplies steam to two 17 by 22 cylinders with Walscheart valve motion. Each cylinder works a short shaft on which is fast a bevel wheel, 33 inches in diameter, on pitch line. These bevel wheels gear into a larger bevel wheel, 49⅝ inch diameter, on pitch line, fast on the main shaft driving the knife wheel placed in the front of the machine. This wheel is 9 feet in diameter, and is set in a round casing with a flaring square front 10 feet wide and the same height. This casing serves to feed the snow into the wheel from the corners of the cut. The wheel contains an inner and outer series of knives. These knives are pivoted on radial pins, and the surfaces of the knives being inclined to one another, the knives are canted when they encounter any snow, and are set so as to slice it off and feed it into the machine. Behind these knives and on the same shaft is a fan wheel composed of a number of radial blades. As the whole wheel is revolved at considerable velocity the centrifugal force causes the snow to fly to the outside of the fan wheel, and as the latter is surrounded by a casing the snow can only escape where an opening is provided for it. This opening is at the top of the wheel immediately behind the headlight. The opening is provided with a movable hood, so that the stream of snow can be regulated and made to fly either to the right or left of the track.

The boiler and engines are protected from the weather by a strong house.

The rotary is under the charge of a pilot, who stands on a platform immediately above the bevel wheels and in front of the smoke-box. By a system of signals he controls the engineers on the rotary and pusher, and by a hand wheel can alter the position of the hood that directs the stream of snow to either side. He has also charge of the ice breaker and flanger for cleaning the rails after the main body of the snow has been removed by the rotary.

The ice breaker is a stout blade of steel, hanging in front of the front wheel of the front truck, and so attached to the journal box and frame of the truck that it rises and falls with the movement of the front truck wheels, and consequently maintains a fixed position—about ⅛ in.—above the top of the rail. The ice breaker and the flanger which follows it can be raised several inches above the track by means specially arranged for this purpose and described below.

The flanger, which clears out snow from both sides of the rail for a distance of about 12 in., is attached in a somewhat similar manner in front of the rear wheel of the front truck.

The eight-wheeled car as above described is followed by a tender carrying water for the supply of the boiler. These two vehicles are propelled into a snow bank by one or more locomotives, as may be required, according to circumstances.

The machines have been found to work so successfully that the alterations are only in detail, and involve no departure from the principle of the rotary.

The snow flanger and ice-plow, which are not shown in the engraving, are now mounted somewhat differently, though the construction and position of the ice-plow and flanger are unchanged. As formerly arranged, both had to be lifted, by means of a steam cylinder, on approaching frogs and switches. If, however, the pilot who controls the rotary shovel and stands in the front part of the house immediately behind the wheel is unable to locate the frogs, etc., it is obvious that the ice-plow would strike and be disabled. To minimize this inconvenience, a safety link was used to suspend the ice-plow. This link being purposely weak was alone broken, and being easily replaced, the delay caused was very slight.

In the present arrangement nothing is injured should the pilot forget the locality of frogs and highway crossings or other similar obstructions. The ice breaker and flanger are hung by springs, which are sufficiently stiff to keep the ice-plow and flanger to their work, but yield when they strike a solid obstruction. The ice-plow and flanger are consequently lifted clear and return to work when the obstructions is passed.

The ice-plow and flanger are now lifted out of gear by eccentrics on the rear end of the main shaft. These eccentrics are normally out of gear when the flanger and ice-plow are at work. The latter are lifted when the eccentrics are thrown into gear by a clutch which can be operated by the pilot.

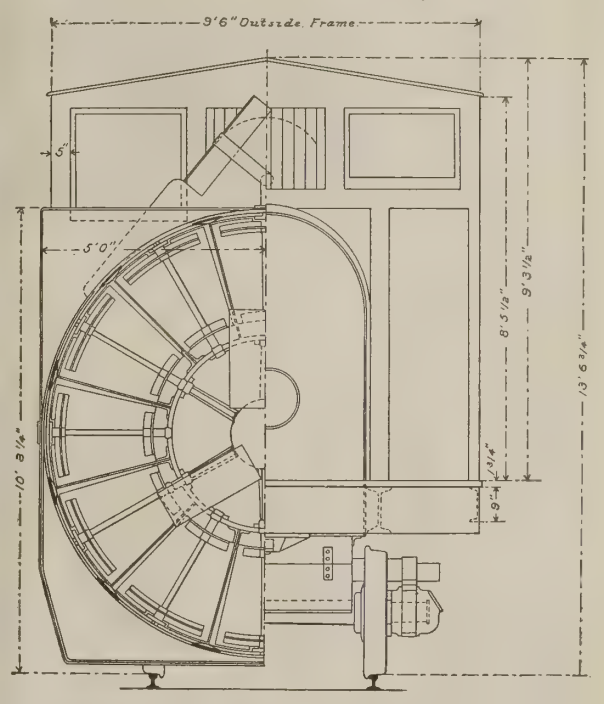
Experience has shown that it is advisable to keep the knife-wheel always running. If there is only a very little snow on the track, it soon collects as the snow-shovel is pushed ahead by the locomotive, and it is more convenient to get rid of it by constantly running the wheel at a slow speed than to wait until the snow has accumulated. It is also more convenient to have the wheel running when a snow drift is unexpectedly encountered.

The other improvements comprise an alteration in the front and lower part of the knife wheel casing, which is expected to diminish the resistance in passing through hard packed snow and ice. The knife wheel is placed nearer the front edge of the casing, so that the snow is more easily gathered in.

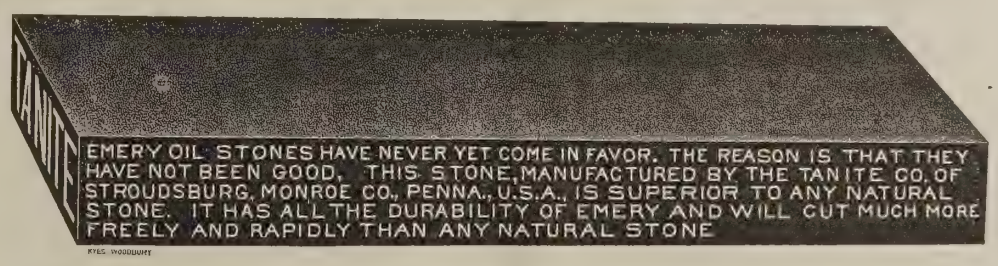
The roof of the house has been strengthened and made flush from end to end, whereas it was formerly highest over the front where the pilot is located. The number of windows has also been diminished, and the windows are divided into several small panes, so that a broken pane can be more easily replaced.

The boiler is provided with a brick arch, and a single nozzle blast pipe is used, and it is anticipated that these and other minor improvements will improve the steaming power of the boiler.

The weight of the rotary in complete working order is about 110,000 lbs.



The Betts Machine Company, Wilmington, Del., have recently shipped one of their improved horizontal boring and drilling machines to Louisville & Nashville Railroad Company, at Decatur, Ala.; one of their 60-inch planers, weight 36,000 lbs., to Wm. Deacon, San Francisco, Cal.; one of their 10 × 16 feet boring and turning mills, 62,000 lbs., to Bonton Foundry Company, Chicago, Ill., and will ship in a few days two of their heavy "frog" planers, 60,000 lbs., to Ramapo Iron Works, Hillburn, N. Y.; one of their 7 × 10 feet boring and turning mills, 34,000 lbs., to Byron Jackson, San Francisco, Cal., and a 48-inch radial drill to Williamsport parties.



SOLID EMERY OIL STONE.

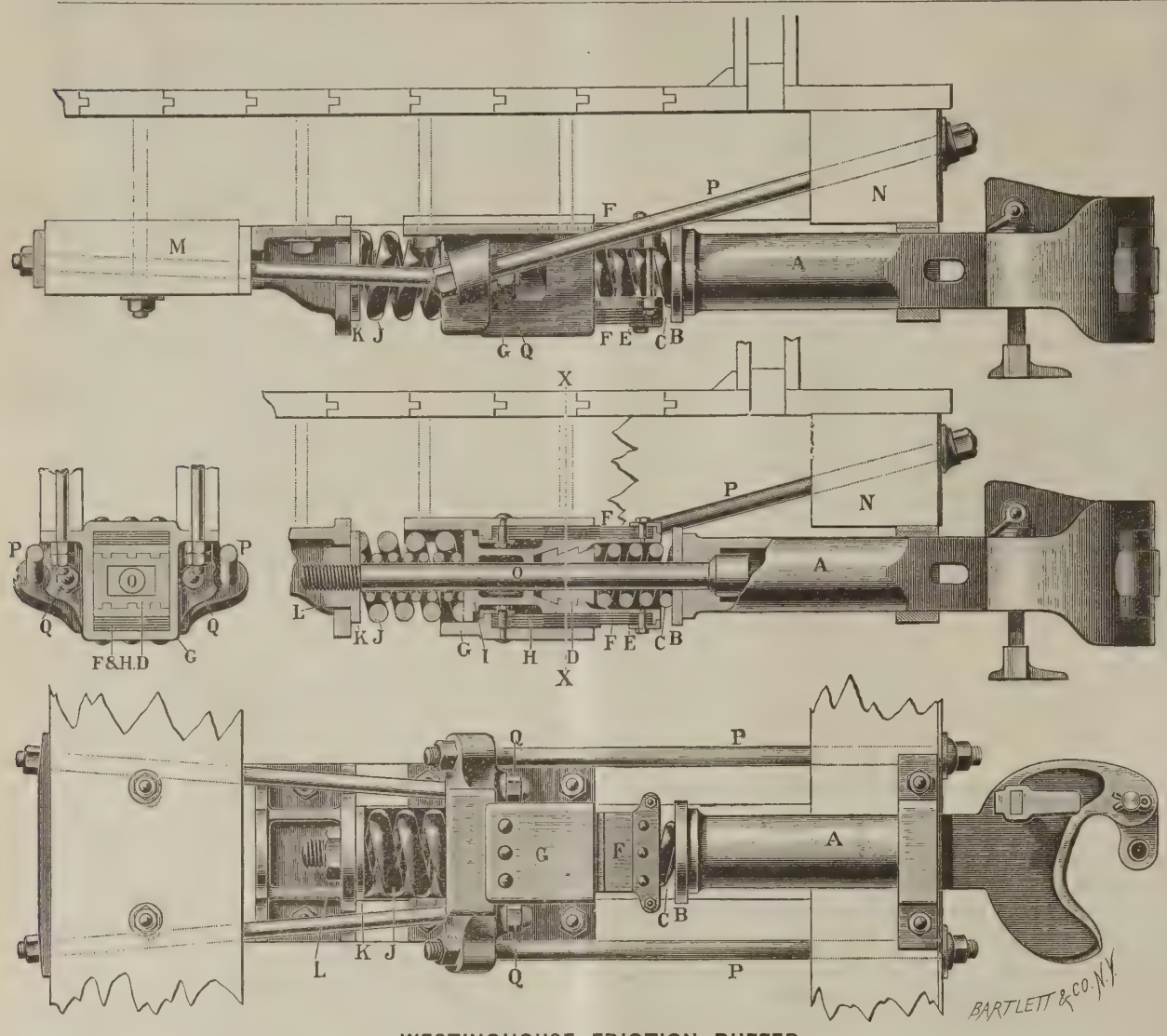
The solid emery oil stone here illustrated is in all respects similar in quality to the famous Tanite emery wheels, so well-known in all railroad shops. Two grades of these stones are made, one for putting on a rough edge and one for a cutting edge on fine tools. The rough edge stone will do the same work that a grindstone will, and the carpenter who carries one in his kit can often do alone what it takes two men to do at a grindstone.

These goods are wholesaled by the Tanite Company, Stroudsburg, Pa. The company are also making a triple coated emery knife grinder which is highly spoken of by users.

Mr. Geo. B. Ross, Buffalo, N. Y., has invented a new automatic anti-freezing steam trap which appears to have merit. The principle of operation is the difference in length between a protected tube made of metal, with a great range of expansion and contraction exposed to the steam and water of a heating system, and a rod outside exposed to the atmosphere. This trap is absolutely frost proof, for the reason that at all temperatures below the point of discharge the valve remains open, and as its operation is not effected by motion or change of position it is well adapted for use on railroad passenger cars and steamboats, and on account of the facility with which it can be adjusted, or, in fact, any place where it is desirable to dispose of condensation without waste of steam.

Beginning with January 1, the name of the firm W. D. Wood & Co., Limited, will be changed to W. Dewees Wood Company, with general offices at McKeesport, Pa., to which place all communications should be addressed.

Williams, White & Co., Moline, Ill., who are making the Burnett & Clifton automatic chute for coaling locomotives, report that they have supplied the chute to the Chicago, Rock Island & Pacific, the Atchison, Topeka & Santa Fe, the Union Pacific, the Chicago, Kansas & Nebraska, the Illinois Central, the Denver & Rio Grande and other roads. The company have special machinery for making the iron work of these chutes, and consequently they can supply them at a lower cost than any railroad company can make them. A curious instance of the convenience of this chute came out in the experience of the Sheffield Mining Company, Sheffield, Ill., on the line of the C., R. I. & P. Railway. The mining company had the "Kerr" chute, and the railway company had put in Burnett & Clifton chutes at the other coaling stations on the road. The mining company soon found that the engineers on the road would not take coal at their mines if they could possibly avoid it, on account of the extra labor and time required by the "Kerr" chute, and the mining company finally put in new Burnett & Clifton chutes in order to restore their trade.



WESTINGHOUSE FRICTION BUFFER.

The annexed engravings give three views of the Westinghouse Friction Buffer as applied to the draw-bar of a freight car.

When the drawhead *A* is pressed back, the first inch of its motion compresses the initial spring *C*, driving back the wedge block *D*, thereby forcing apart the wedge plates *EE* and compressing the interlocked sets of movable and fixed friction plates *FF* and *HH*. Any further inward movement of the drawhead results in movement, in the same direction, of the wedge plates *EE*, movable friction plates *FF* and thimble casting *I*, and through them the compression of the main draft spring *J*. That portion of the thrust due to the compression of the initial spring and the friction between the plates *FF* and *HH* is taken up and transmitted to the end sill of the car body by main stay bolts *PP*. That portion of the thrust due to the compression of the main draft spring is taken up by the back casting and body bolster. The total thrust is thus passed through an elastic medium and distributed very generally through the sills.

When the drawheads are subject to a pull, as from the traction of a locomotive, the main draft spring draws against the thimble casting, which is normally seated against an internal flange of the housing *G*, and the buffing apparatus is then inoperative.

The initial spring is supplied with the buffing apparatus, but the main draft spring (provided by railroad companies) may be same as that now in general use.

Capacity as determined by average of several tests made in Riehle & Olsen machines.

Resistance due to initial spring	13,000 lbs.
" " friction	37,445 "
" " draft spring	18,000 "
Total resistance	68,445 lbs.
Work done in compressing friction buffer	8,388 foot lbs.
Work done in compressing present ordinary draft spring, 6 × 8 inches, 1¾ inch motion, and 18,000 lbs. capacity	1,314 "
Ratio of work done in compressing buffer to work done in compressing ordinary draft spring $\frac{8388}{1314} = 6.46$	

In order to secure uniformity, The Union Switch and Signal Company reserves the right to manufacture the main casting *G*, and its fittings, including the initial spring *C*, but excluding bolts and washers *B* and *K* and main draft spring *J*.

It will be noticed that, outside of the special parts above referred to, there are required four simple bolts, to take the place of expensive forgings usually required with other forms of draw gear, and the saving effected in this respect largely offsets the cost of the special apparatus furnished by this company.

The friction buffer will absorb from six to seven times the momentum that can be absorbed by the ordinary draft springs before the dead blocks come together, and thus the shock to the car body is lessened by the difference in the amount of momentum the two kinds of apparatus will absorb.

The friction buffer is constructed so that the working parts are cheaply and quickly replaced, and the breaking of the end sills, main sills, the jarring loose of bolts, racking of the car frame, shifting of the load, breaking of the dead blocks and drawheads are correspondingly guarded against.

In ordinary drawgear, the action and reaction of the main springs being equal, the breaking in two of trains is a common occurrence, due to the traction of the engine and the reaction of the springs. The friction buffer acts to offer great resistance to inward movement, and retards the outward movement, so that the reaction of the main draft springs is inappreciable.

In the ordinary operation of trains, the dead blocks are invariably brought together in starting and stopping, and as frequently as the train is stretched or compressed. With the friction buffer these frequent shocks will be avoided; and in cases where the cars are run together with a force sufficient to exhaust the power of this device, the car framing, with the ordinary drawgear, would receive a severe shock.

The Master Car-Builders' standard coupler has been recommended for adoption, and is being largely applied. With this form of coupler, the dead blocks are inoperative in all cases where cars come together with hooks closed. In such cases, the friction apparatus will prove invaluable. The decrease in cost of repairs, from breakage of the drawgear and hooks, will be a marked item of economy.

The use of automatic couplers will lead to the switching of cars at a higher rate of speed than has heretofore been common; engineers having had regard for the brakemen, who have heretofore gone in between the cars; and the breakage that will result from the higher speed will be, without the use of this buffer, greatly in excess of the expectation of the advocates of automatic couplers.

Each buffer put in the train benefits the balance, by absorbing momentum which would otherwise be expended in damaging the cars.

The method of hanging the apparatus is such, that the strains due to buffing are transmitted through several different members, instead of being concentrated.

If the ordinary form of gear were to be made to withstand the blow that this new device provides for, the cost of the former would be much greater than of this complete apparatus.

The net increased cost of a car, due to the application of this friction buffer will be more than repaid, each year, by the saving in damage to cars and goods, and consequent decreased cost of repairs.

Records kept by railroad companies show that of all freight equipment cars held in shops or on tracks for repairs, over 60 per cent. have damaged draw-gear or end sills.

Heretofore, the arguments in favor of any particular form of buffing apparatus, have not led to the general adoption of one kind.

This form affords an opportunity to have uniformity in this one respect, at least in the construction of freight cars.

The form of this apparatus is such as to admit of its application, with a minimum amount of expense, to cars now in service.

The buffers are made by the Union Switch and Signal Co., Pittsburgh, Pa.

Mr. B. F. Sturtevant, manufacturer of blowers, exhaust fans and beating apparatus, has moved his office from 115 Purchase street to 34 Oliver street, Boston. The change is due to a large increase of business.

The Wakefield Rattan Company, Boston, has issued an illustrated catalogue, showing the great variety of seats and other articles which they make, and giving directions about ordering goods. Parties contemplating the purchase of this highly wholesome kind of seat ought to send for this catalogue.

The Calumet Iron and Steel Company, Chicago, have put on the market a parallel-sided, chisel-pointed steel nail, which has merits that recommend it highly to car-builders and others who want a nail to hold well. The chisel point passes through the wood by cutting, separating and deflecting the fibres slightly downward in a position where they cling compactly to the sides of the nail, naturally giving it greater holding power than others. By actual tests, the holding power is found to be from 30 to 75 per cent. greater than that of the old cut nail.

The Magnolia Anti-Friction Metal Company, of New York, have received the highest award for their Magnolia metal from the American Institute. The Chicago Tire and Spring Company, of Chicago, states that it has used satisfactorily Magnolia metal in the journals of its mill for rolling locomotive tires where there is a pressure of 5,000 pounds per square inch. The company had trouble with brass bearings, but now uses Magnolia metal exclusively.

To the Land of Flowers.

The Queen & Crescent route announce the opening of their through car service to Florida, taking effect Dec. 23, 1888.

Travelers via this line can now step into a sleeping and buffet car at Cincinnati and go through to Jacksonville, Fla., without change of cars, in 28 hours. Mann's boudoir, buffet and sleeping and Pullman buffet and sleeping cars alternately.

Our Directory.

We note the following changes since our last issue. Our readers will do us a great favor by giving us prompt notice of any changes that may come to their knowledge or of any error that may be noticed in our list:

Alabama Midland.—O. R. Whitney has been appointed superintendent of motive power, with office at Montgomery, Ala.

American Midland.—Mr. G. W. Ettenger has been appointed purchasing agent, with headquarters at 115 Broadway, New York.

Atlantic & Danville.—A. D. Bateman, previously superintendent of the main line, has been appointed superintendent of all divisions, and Z. E. Cheatham, previously superintendent of the James River Division, has been appointed assistant superintendent of all divisions.

Baltimore & Ohio.—Charles F. Mayer has been elected president of the road, vice Samuel Spencer.

Chicago, Burlington & Quincy.—The following appointments are announced: L. E. Johnson, superintendent of the Chicago Division, vice George Alexander, assigned to other duties. E. M. Herr, superintendent of the St. Louis Division, vice L. E. Johnson, transferred. W. W. Nichols, superintendent of telegraph, vice E. M. Herr, promoted.

Chicago, Santa Fe & California.—The office of Mr. M. J. Rogers, master mechanic, has been removed from Streator to Chicago.

Cincinnati, Jackson & Mackinaw.—F. W. Deibert has been appointed master mechanic in charge of locomotive and car departments, with headquarters at Toledo, O.

Des Moines & Kansas City.—John C. Newton is now in charge of this road as general manager, in place of James Donohue, superintendent.

Des Moines & Northwestern.—E. P. Shearer has been appointed master mechanic of this company and the St. Louis, Des Moines & Northern, vice F. W. Morse, resigned.

Idaho Central.—The following changes in the management are announced, taking effect Nov. 10. E. S. Van Kuran, superintendent, succeeding J. Hunter, resigned; Edgar M. Heigho, car accountant, to succeed R. C. Oglebay, resigned.

Illinois Central.—J. B. Kemp has been appointed superintendent of the Memphis Division, vice Maj. M. Burke resigned, to go in other business. The Aberdeen Division, from Aberdeen, Miss., to Durant, Miss., will hereafter be discontinued as a separate division and merged with the Mississippi Division, under the superintendency of Horace W. Clarke, with headquarters at Jackson, Tenn.

Kansas City, Fort Scott & Memphis.—E. J. Perry having been assigned to other duties, H. S. Mitchell has been appointed division superintendent of the Kansas City, Springfield, Joplin & Cherryvale divisions, and the Kansas City, Clinton & Springfield Railroad, with headquarters at Fort Scott, Kan.

Lake Shore & Michigan Southern.—J. T. Harahan has been appointed assistant general manager.

Louisville & Nashville.—J. T. Harahan has resigned the position of general manager. George D. Wadley has been appointed superintendent of the Owensboro & Nashville, vice E. H. Mann, transferred. W. G. Sala, assistant superintendent of the South and North division, has been transferred to the position of assistant superintendent of the Knoxville branch. W. M. Newbold, assistant superintendent of the St. Louis and Henderson division, succeeds him.

New York, Lake Erie & Western.—Mr. John W. Cloud has resigned the position of superintendent of motive power. Messrs. J. Van Vechten, J. H. Vreeland and Blackburn, master mechanics, have resigned.

Northern Pacific.—Mr. J. E. Phelan has been appointed master mechanic of the Missouri division, with headquarters at Mandan, Dak. Mr. N. D. Root, who has been superintendent of the East & West Minnesota and Wisconsin divisions, with headquarters at Brainerd, Minn., has been appointed assistant general manager of the middle division in place of Mr. Robert Law, with headquarters at Helena, Mont. Mr. Frank Green, superintendent of the Missouri division at Dickinson, Dak., has been appointed superintendent of the East & West Minnesota and Wisconsin divisions, with headquarters at Brainerd, Minn., in place of Mr. N. D. Root, transferred. Mr. E. R. Knowlton, formerly chief train dispatcher of the Montana division, has been appointed superintendent of the Missouri division, in place of Mr. F. Green, transferred. Headquarters, Dickinson, Dak.

Owensboro & Nashville Ry.—Geo. Dole Wadley has been appointed superintendent of this company vice E. H. Mann, transferred. Appointment took effect Nov. 21, 1888.

Missouri Pacific.—Mr. R. M. Richardson, master mechanic of the St. Louis & Iron Mountain divisions, has resigned and is succeeded by Mr. Frank Reardon.

St. Paul, Minneapolis & Manitoba.—Mr. H. C. Ives has been appointed superintendent of the Breckenridge division. Mr. J. A. Mayer, superintendent, has been transferred to the Montana division.

Rome, Watertown & Ogdensburg.—E. S. Bowen has been appointed acting general manager, with office at Oswego, N. Y. Edwin Parsons has been appointed purchasing agent and assistant to the general manager, with headquarters at Oswego, N. Y.

Union Pacific.—G. M. Cumming, general manager of the St. Joseph & Grand Island, has been appointed superintendent of the Wyoming Division of this road, with office at Cheyenne, Wyo., vice C. E. Murtell, resigned.

Wabash, Chester & Western.—J. R. Hawkins has been appointed superintendent. He will have general supervision of the track, bridges, motive power and rolling stock. Appointment took effect Nov. 7, 1888.

Employment.

A young man, M. M. of a R. R., locomotive, mechanical engineer and draughtsman, 18 years' practical experience, would confer with officials desiring the services of a competent man. Best references and reasons. South or West preferred. Address "Business," care of NATIONAL CAR AND LOCOMOTIVE BUILDER.

NATIONAL CAR AND LOCOMOTIVE BUILDER

FEBRUARY, 1889.

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General Manager Gault, of the Cincinnati, New Orleans & Texas Pacific, has closed a contract with the Litchfield car works, of Litchfield, Ill., for the construction of 100 refrigerator cars, with the privilege of doubling the order.

The United States Rolling Stock Company are building 27 passenger cars in their works at Chicago for a Southern railroad. These are the first passenger cars built by the company, but they have excellent facilities for doing the work, and we understand that they are going to make the building of passenger cars a regular branch of their business.

Car couplers of the M. C. B. type, as made by the Consolidation Coupling Co., were subjected to a series of very hard tests lately in the yards of the New York Central at West Albany. The coupler was tested both for impact and pulling resistance, and went through the ordeal very satisfactorily. Shocks equal to that given in a collision at 20 miles an hour were given to the coupler. The officers of the railroad company are highly satisfied with the tests.

One of the street railway companies in New York are running some of their cars with electricity supplied by storage batteries of the Julien type carried in the cars. About 35 H. P. of electrical energy is charged into the batteries in a car and that is found sufficient to supply power for two round trips, making a continuous run of 24 miles, with a large safe margin left for any emergency. In fact that mileage is said to expend only about 15 H. P. of the energy. The power is said to be cheaper than that supplied by horses.

A gentleman in the employ of Yarrow & Co., the famous ship builders of London, writes us that they have recently received some tools from Brown & Sharpe, Providence, R. I., which are giving great satisfaction and doing valuable work that is opening the eyes of the owners to the merits of American machinery. The same firm are making a great success in the building of small launches with engines run by alcohol vapor, an invention which they acknowledge to be of American origin.

By a general order issued by General Manager Hickson of the Grand Trunk, the announcement is made that the jurisdiction of Mr. Herbert Wallis, mechanical superintendent, is extended to the locomotive and car department throughout the whole system, including what was formerly the Great Western of Canada, and the lines in the Eastern States of the United States. Mr. W. McWood takes charge of the whole car department under direction of Mr. Wallis, and Mr. C. K. Domville undertakes the charge of the company's foundries at Hamilton.

The use of the electric light on trains was begun on the night of Jan. 17 by the Chicago, Milwaukee & St. Paul Railroad. Two vestibule trains of nine cars each, steam heated, were started with the electric light—one from Chicago for St. Paul, the other in the opposite direction. The electricity is furnished by a dynamo in the baggage car. In the sleeping cars there is an incandescent burner in every section, so that the occupant can read a book or paper while lying in bed. This is the very latest agony in the development of luxuries of travel.

President Clark, of the New York, New Haven & Hartford, is reported to have awarded the contract for building ten 18-inch cylinder and 24-inch stroke passenger and freight engines to the Rhode Island Locomotive Works. Plans will be furnished by Mr. John Henney, superintendent of motive power for the road.

During 1888 the St. Charles Car Company turned out 3,129 freight cars, besides molding 3,000 car wheels and completing 100,000 tons of cast and wrought iron work. The company employed 900 men, and the average weekly payroll amounted to $7,500. The company intend increasing their capital stock $1,000,000 for the purpose of raising money to build new shops.

The Fox Solid Pressed Steel Company has been organized for the purpose of building the Fox steel truck, which was exhibited at Alexandria Bay. This company is closely associated with the Joliet Steel Company, and they are erecting a plant at Joliet, Ill., for the manufacture of the truck. The plant, which consists of heavy hydraulic machinery and the necessary heating furnaces, is estimated to cost $250,000. The principal officers are: A. J. Leith, president; H. S. Smith, vice-president; W. R. Stirling, superintendent, and E. W. M. Hughes, chief engineer.

The project of a trip of the American engineering societies for a joint visit to Europe is beginning to take tangible form. E. N. Carbutt, president of the Institution of Mechanical Engineers, of London, has tendered an invitation to the American Society of Mechanical Engineers, and the latter have now issued a preliminary circular, asking members of the three societies, the Civil, Mechanical and Mining Engineers, to inform the committee, W. R. Hutton and W. R. Wiley, whether they can attend. About eighty members of the different societies have intimated that they will make the trip, so that its success is assured.

A train accident happened recently on the Pan Handle railroad which gave an excellent illustration of the perfection reached by good injectors as sure water feeders. Two trains had a collision, and there was a pretty severe smash up. The enginemen had time to jump and no serious injury was sustained by any of them. One of the engines was equipped with the Sellers 1887 automatic restarting injector, and it was found when the men got to the engine that, although the cab was smashed, the injector pipes had escaped fracture, and the injector was working as well as if nothing had happened to disturb its action.

De Lesseps would have been a marvel if he had persuaded the people or the Government of France to see him through with the Panama Canal. A contractor but recently returned from the Isthmus says that more money has been sunk in the ditch than is required to complete it. I inquired how this money had been wasted. "Through sheer cussedness," he replied. "I'll give you an instance. The best make of American locomotives, Baldwin's, I think, are used for hauling away the earth as it is excavated. They pull the cars from the cuts out onto the dumps, where the unloading is done. The tracks are down grade, and if a train gets loose, nine times in a dozen it goes over the dump. I counted no less than twenty brand new Baldwin engines lying at the base of these dumps. It was impossible to get them back on the rails without taking them to pieces or lifting them up with derricks. There were no derricks big enough to handle them, and taking them apart was too much trouble, or the men didn't know how to go about it; consequently they were left where they fell, to be covered up by the waste earth. These twenty locomotives must have cost, delivered at the Isthmus, 40,000 francs apiece. So here's one item of 800,000 francs literally buried out of sight and nothing to show for it."

A saw mill has lately been erected at Brewton, Ala., which is a monster in size. Over 3,000,000 feet of lumber were used in the erection of the mill and the buildings connected with it. The logging ditch is fourteen miles long. One mile of rails are used in the drying kilns and transfer tracks. The gang of 36 saws, with rotary, edger, cut-off, lath and shingle machines, etc., will be driven by two engines, 24 × 36, and 20 × 30, which are fed by four 60-inch by 16 foot tubular boilers. These are incased in a brick fire-proof boiler room, by the side of which stands a two-story shaving room 20 × 40, into which are deposited the shavings from the large planing mill. More than 6,000 cubic yards of earth have been removed from the creek to prepare a suitable and satisfactory log pond, from which will be drawn 1,000 logs a day when the mill is in operation. In the planing mill, which is 164 × 288 feet, ten cars can be loaded at one time, regardless of wind or weather. In front of the planers 24 trucks of lumber can stand ready to be pushed through the four flooring mills, or surfacers—and at the end of these flooring mills the board lands on an endless chain which carries it to any of the cars, or to the pile where it is intended to place it. A million and a half feet of dressed lumber can be stored without infringing upon the loading space.

Many persons believe that Mr. C. P. Huntington, the well-known railroad magnate, is owner of the *New York Star*, and not a few persons interested in the sale of railroad supplies are under the impression that giving support to the *Star* is a likely way of securing business connection with the Huntington roads. Some talk which Mr. Huntington had with a reporter of the New York *Tribune* shows that his interest in the *Star* is exceedingly remote. The money that Mr. Huntington put in the paper was given in the form of loans to Mr. Dorshiemer, who was struggling unsuccessfully to make the journal a financial success. The *Tribune* says: All told he (Mr. Dorshiemer) borrowed $42,000 from Mr. Huntington to sink in the *Star*, and I have it on the highest authority that seventy-five other men in this city lent him from time to time sums ranging from $1,500 to $2,500. In round numbers the decrepitude of the *Star* forced him to borrow $200,000. These creditors are the present owners of the paper. Some of them are millionaires. One of them bought stock in the *Star* because he got the impression that Mr. Huntington was doing so. As the abandonment of the paper meant a loss to each of these men, they concluded to form a company and continue the publication, either to lose a little more or get back everything. Said Mr. Huntington: "I told them to go ahead and do as they liked; if they could make anything out of it for me, all right; if they couldn't, all right. I would not lend money to anybody if I had to go and look after it. The stock is not worth a barleycorn to me, so far as I know. I've never been near the office and don't even know who is the managing editor of the paper."

Change of Date of Master Car Builders' Convention.

After our paper is on the press, Jan. 29, we receive from Mr. Forney, secretary of the Master Car Builders' Association, a circular dated Jan. 15, intimating that the day of meeting of the Master Car Builders' Convention is postponed two weeks for the alleged reason that hotel accommodations could not be obtained for the regular date of the meeting. This is a very astonishing decision, and it looks as if the convenience of members is going to be made subordinate to the interests of hotel keepers. The Master Car Builders' Association is crushed into very small account when the Annual Convention cannot be held at the regular time because a hotel-keeper is not ready to receive the guests. It used to be that hotel-keepers were offering every inducement to get these conventions held in their houses, and we cannot help thinking that accommodation might have been found this year on the second Tuesday of June if a sincere effort had been made. A change of this kind is very inconvenient to many of the members, and its effect will be to materially reduce the attendance. Years of experience convinced the members that the beginning of June was the time most suitable for holding the convention, and something more than the interests of hotel keepers should be necessary to lead to a change of date. The convention will be held at Saratoga Springs, N. Y., with headquarters at Congress Hall.

Compound Freight Locomotive.

Mr. T. W. Worsdell, locomotive superintendent of the Northeastern (England), has just put in service a new class of compound locomotive for freight service. This engine has six coupled wheels, 61½ inch diameter on tread, and a pair of radial trailing wheels. A supply of coal and water is carried by the engine itself, dispensing with a separate tender. The engine is thus shorter, handier, and cheaper than a tender engine of the same tractive power, while the amount of coal and water carried is amply sufficent for short journeys or for switching purposes. The cylinders, wheels, motion, etc., are interchangeable with those used on the main line freight engines with a tender. The total wheel base is 22 feet 6 inches, and the total length of frames between buffer or bumper beams is 32 feet 3 inches, or fully 15 feet shorter than an engine and tender of the same power. The engine is inside connected, the high-pressure cylinder being 18 inches diameter by 24 inches stroke, and the low-pressure cylinder being 26 inches diameter by 24 inch stroke. The working pressure is 160 pounds per square inch. The weight on the drivers with tanks and coal bunker full is 101,600 pounds, and the total weight of the engine is 121,000 pounds. The capacity for water is 1,560 gallons and the coal bunkers hold 4,500 pounds. The total heating surface is 1,136 square feet, and the grate area is 17.23 square feet. All the axles and the boiler and fire-box shell are steel, and the wheel skeletons are cast steel. The inside fire-box is copper and the tubes brass. Joy's motion and the Allen or Trick Valve is used. The latter has 1¼ inches lap and 5½ inches full travel. The engine will be employed in hauling coal trains consisting of 40 four-wheeled cars, each holding 10 gross tons. The total weight of train, including engine and caboose, is about 1,570,000 pounds. It is estimated that when working with a three-fold expansion the engine would exert a tractive force of about 17,000 pounds, and would therefore be capable of hauling this train up a grade of 40 feet per mile.

Combustion in Locomotive Fire-Boxes.

BY ANGUS SINCLAIR.

To properly comprehend what happens to keep a fire burning; we must understand something about the laws of nature as they are explained under the science of chemistry. Practical men are generally easily repelled by the strange names which they meet with in reading anything where chemical terms are used. An engineer or fireman who is ambitious to learn the principles of his business ought to attack the hard words with a little courage and perseverance, when it will be found that they are not nearly so difficult to make out as at first they appeared to be.

SCIENTIFIC FIRING.

A man may become a good fireman without knowing anything about the laws of nature that control combustion. If he become skillful at making an engine steam freely while using the least possible supply of fuel, he has learned by practice to put in the coal and to regulate the admission of air in a scientific manner. That is, he puts in the exact quantity of fuel to suit the amount of air that is passing into the fire-box, and in the shape that will cause it to produce the greatest possible amount of heat. This degree of skill is often reached by men ignorant of nature's laws; but it is attained by groping in the dark to find the right way. A man who has learned his skill in this manner is not, however, perfectly master of the art of firing, for any change of furnace arrangement is likely to bewilder him, and he has to find out by repeated trying what method of firing suits best. He is also liable at times to waste fuel uselessly, or to cause delay by want of steam when anything unusual happens.

A knowledge of the laws of combustion teaches a man to go straight to the correct method, and the information gained enables him to deal intelligently with the numerous difficulties which are constantly arising through inferior fuel, obstructed draft due to various causes, and fire-boxes badly designed. To illustrate: Engineer West was pulling a passenger train one day and his grates got stuck. He ran as far as he could till he could do nothing more for want of steam, then he stopped and cleaned the fire; loss of time over one hour with an important train. Engineer Thomas, on the same road, had a similar experience with the grates; but he understood combustion and knew that all the fire wanted was air put in so that it would strike the fire before it passed into the flues. He got an old scoop and rigged it in the fire-box door slanting towards the surface of the fire. He did not need to clean the fire, and he went in nearly on time. He could not get air to mix with the fire through the grates, so he devised a plan to inject it above the fire.

ELEMENTS THAT MAKE UP A FIRE.

The nature of fuel, the composition of the air that fans the fire, and the character of the gases formed by the burning fuel, and the proper proportions of air to fuel for producing the greatest degree of heat, are the principal things to be learned in the study of the laws relating to combustion. The air above, the earth beneath and the waters under the earth, are all composed from about sixty-five elementary substances which have combined together to form the immense variety of substances found in and around the globe.

A simple substance or element is something out of which nothing else can be got, no matter how finely it may be divided, or what searching tests it may be subjected to. Elements unite together to form compounds or combine with compounds to form other compound substances, which are generally very unlike the ingredients that made them. No one could ever tell from the appearance of a substance whether it is a simple element or a compound. That has to be found out by the searching tests of chemistry. Pure water when it falls from the clouds looks as simple as anything in nature; yet water is a compound formed by the union of two gases, oxygen and hydrogen. The liquid metal mercury on the other hand is not popularly looked upon as a simple substance; yet there is nothing in it except mercury. When elements or compounds combine to form new substances, they always do so in fixed proportions by weight, and if there is any excess of any substance present it does not combine but remains unused. It is important to remember this, as it has a direct bearing upon the economy of fuel. A few of the principal elements are oxygen, hydrogen, nitrogen, carbon, sulphur, iron, copper, mercury, gold and silver. We will have to deal principally with the four first mentioned.

The elements which perform the most important functions in the act of combustion are oxygen and carbon. Carbon is the fuel, and oxygen is the supporter of combustion. Combustion results from a strong natural tendency that oxygen and carbon have for each other, but they cannot unite freely till they reach a certain high temperature, when they combine very rapidly with violent evolution of light and heat.

Oxygen is the most abundantly diffused element in nature. It is never found existing in a pure state, but it combines with all other elements except one. Combined with the substances that form rocks, it constitutes one-third of the solid crust of the earth; eight-ninths by weight of all the water on the globe is oxygen; and nearly one-fourth by weight of the atmospheric air is composed of the same element. Its presence is vital to the existence of all animated nature.

All the fuel used for steam making is composed of carbon or the compounds of carbon and hydrogen. Carbon is the principal element found in trees, and in all woody fiber; and is the fundamental ingredient of all kinds of coal. The ordinary run of American bituminous coal contains from 50 to 80 per cent. of fixed carbon, which is the coke, and from 12 to 35 per cent. of volatile substances, which burn with a lurid flame, and supply the ingredients of coal gas. These inflammable compounds are known as hydro-carbons, being combinations of hydrogen and carbon. Anthracite coal differs from other coals in the fact that it consists principally of fixed carbon, with but little volatile matter. Good anthracite contains as high as 90 per cent. of pure carbon.

In treating of combustion it is constantly necessary to speak of measuring gases by weight. How air and other gases can be weighed as if they were sugar or tea seems a puzzle to many men not acquainted with laboratory work; but they must take it for granted that these things are done

All the air required for furnace combustion is taken from the atmosphere, which consists of a mixture of 1 pound of oxygen to 3.35 pounds of nitrogen; or by volume 1 cubic foot of oxygen to 3.76 cubic feet of nitrogen. Nitrogen is an inert, neutral gas that gives no aid in sustaining life or in promoting combustion; but it passes into the furnace with the oxygen and has to be heated to the same temperature as the other gases.

Before dealing with the action of the air on the fuel resting on the grates, we might mention that scientists have devised a scale of measurement of heat, which is just as necessary for the comprehension of combustion as ordinary weights and measures are for mercantile purposes. The amount of heat necessary to raise the temperature of one pound of water at its greatest density one degree Fahrenheit is called a heat unit, or sometimes a thermal unit.

APPLYING THE PRINCIPLES OF COMBUSTION TO A FIRE-BOX.

Having mentioned the leading elements that take part in keeping a fire burning, we will now apply the operation to the work done in the fire-box of a locomotive. Let us take a common form of engine with a fire-box 72×35 inches, which makes about 17 square feet of grate area. The engine starts with a fairly heavy train and has to keep up a running speed of 40 miles an hour. To maintain steam for this work the engine burns 60 pounds of coal per mile, which is equal to 2,400 pounds per hour. This requires that about 141 pounds of coal must be burned on each square foot of grate surface every hour, a very rapid rate of combustion, but a rate common enough on many railroads. We will assume that the engine is of the kind most commonly found pulling our passenger trains, which have no other means of admitting air to the fire except through the ash pan.

HEAT VALUE OF THE PROPER ADMIXTURE OF AIR.

When the air, drawn violently through the grates by the suction of the exhaust, strikes the glowing fuel, the oxygen in the air separates from the nitrogen and combines with the carbon of the coal. It has been mentioned that elements unite in certain fixed proportions. In some cases the same elements will combine in different proportions to form different kinds of products. If the supply of air is so liberal that there is abundance of oxygen for the burning fuel, the carbon will unite in the proportion of 12 parts by weight (one atom) with 32 parts by weight of oxygen (two atoms). This produces carbonic acid, an intensely hot gas, and therefore of great value in steam making. If, however, the supply of air is restricted and the oxygen scarce, the atom of carbon is contented to grasp one atom of oxygen, and the combination is made at the rate of 12 parts by weight of carbon to 16 parts by weight of oxygen, producing carbonic oxide gas, which is not nearly so hot as carbonic acid gas. It makes a very important difference in the economical use of fuel, which of these two gases is formed in the fire.

One pound of carbon uniting with oxygen to form carbonic *acid* gas generates 14,500 units of heat, or sufficient to raise 85 pounds of water from the tank temperature to the boiling point. On the other hand, when one pound of carbon unites with oxygen to form carbonic *oxide* gas, only 4,500 heat units are generated, or sufficient to raise 26½ pounds of water from the temperature of the tank to the boiling point. The same quantity of fuel, it must be remembered, is used in both cases, the only difference being that less oxygen is in the fire mixture.

VOLUME OF AIR NEEDED TO FEED A FIRE.

Our engine using 2,400 pounds of coal per hour has to burn 2⅛ pounds per minute on each square foot of grate. A very large volume of air has to pass through the grates to supply all the oxygen necessary to combine with the quantity of coal mentioned. The combining proportions of carbon and oxygen to form carbonic acid being 12 to 32, the combustion of each pound of carbon requires 2⅔ pounds of oxygen. It takes 4 35 pounds of atmospheric air to supply one pound of oxygen, therefore at the least calculation it will take more than 11½ pounds of air to provide the gas essential to the economical combustion of each pound of coal. But practice has demonstrated that where combustion is rapid, the fuel must be saturated with the air that contains the oxygen, bathed in it as it were, otherwise a large portion of the furnace gases will pass away uncombined with the element that gives them any heating value. So it is estimated that at least 20 pounds of air must be passed through the grates of a locomotive to supply the oxygen for each pound of coal burned. At this rate our engine must draw in $20 \times 2\frac{1}{8} = 46.66$ pounds of air per minute through every foot of grate area. One pound of air, at ordinary temperature and atmospheric pressure, occupies about 13 cubic feet; so it takes over 600 cubic feet of air to pass every minute through each square foot of grate. This volume of air would be sufficient to fill a cylinder 18 × 24 inches nearly one hundred and seventy times. Or to put it another way, if there were no obstruction to the passage of air through each foot of grate, a trunk of air over 600 feet long has to pass into the fire every minute. As more than half the opening is obstructed by the iron and coal, a column at least 1,200 feet long has to be admitted each minute. With some forms of grates the openings are much more restricted, and consequently the inward rush of air must be faster in proportion.

VELOCITY OF THE FIRE GASES.

There are several practical objections to the air blowing through the grates like a hurricane. The high speed of the gases lifts the smaller particles of the fuel and starts them towards the entrance of the flues, helping to begin the action of spark throwing. Where they find a thin or dead part of the fire, the gases pass in below the igniting temperature, or tend in spots to reduce the heat below the igniting point, and go away unconsumed, at the same time making a cold streak in the fire-box, chilling the flues or other surface touched and starting leaks and cracks. Then the great volume of air has, under ordinary circumstances, to be heated up to the temperature of the fire-box, and a considerable part of the heat produced from the coal has to be used up doing this before any of it can be utilized in steam making. When a large volume of gas is employed it must be passed through the furnace and tubes at a high velocity, the result being that there is not sufficient time for the heat to be imparted to the water; consequently the gases pass into the stack at a higher temperature than would be the case if the movement of the gases were slower. One can get a good personal illustration of this by passing his hand through the flame of a gas burner.

Our engine is drawing in 600 cubic feet of air per minute through each square foot of grate, that is 600 by 17 equals 11,200 cubic feet for the whole grate area. The act of combustion is turning 40 pounds of coal per minute into gas, adding about 300 cubic feet more to the volume. This cloud of gas has to pass out through 202 two-inch flues that give a total opening of 485 square inches, equal to 3.36 square feet. The body of gas reduced to this diameter makes a column over 3,400 feet long, so it must pass through at a velocity of at least 3,400 feet per minute.

THREATENED LOSS OF HEAT.

From these figures it will be understand that in firing; loss of heat is threatened from two opposite directions. If there is not enough air admitted, a gas of inferior heating power will be generated, and a waste of heat will take place equal to the difference between 26½ pounds of water evaporated by the heat from one pound of coal burned as carbonic oxide, and 85 pounds of water evaporated when the same weight of coal is burned to carbonic acid gas. If the admission of air is greater than what is necessary, heat will be wasted in proportion to the quantity needed to raise the temperature of the superfluous air up to the heat of the furnace. Those who have noted the difference in the fuel needed to heat a small and a large room, thirty or forty degrees, may readily understand the quantity of coal that must be wasted raising about 1,000 degrees the temperature of the blizzard of extra air that is often passing through the fire-box of a locomotive. Then, as has been mentioned, an extra supply of air causes an increased speed of draft, and this prevents the sheets and flues from abstracting as much heat as they would if the speed of the gases were slower.

IGNITING TEMPERATURE OF THE FIRE.

The igniting temperature of the fire has been repeatedly mentioned. Everybody meets daily with illustrations of the fact that fuel will not burn till it has been raised to a certain heat. If you put a piece of wood or coal on the fire it remains unchanged for a time till the temperature at which it combines with oxygen is reached, when it begins to burn. The point of heat at which it begins to burn is called the igniting temperature. Different kinds of fuel have different igniting points. Coal gas does not burn below a red heat of iron, and carbon has a still higher igniting point. If you take a piece of iron, heated dim red, and try to light an illuminating gas jet with it you will not succeed. Increase the heat till the iron approaches orange color, and it will then light the gas. From this it will be learned that the igniting temperature of hydro-carbon gas is about the cherry heat of iron. As the igniting temperature of carbon is still higher, it will be understood that coal must be kept at a higher temperature still to make it burn.

When wood, coal or gas will not begin to burn outside till they have been raised to the heat mentioned, it may be readily understood that they will not burn in a locomotive fire-box if they are not up to the igniting temperature. As

the active portion of the fire is constantly distilling gases from the fuel that rise upwards and require a high temperature for their combustion, it will readily be seen that a great waste of heat must happen when the temperature of any part of the fire-box gets so low that the gases pass away unconsumed. So the fireman ought to make it his business to see that the fuel in any part of the fire-box is not permitted to fall below the temperature of combustion. It may be said or believed, that the heat in the fire box is so high that it is always up to the igniting temperature. This would be a mistake. The rush of cold air is so great, that a thin part of the fire readily permits air that is not up to the igniting temperature to pass through, and it chills all the gas it touches. When a heavy charge of coal is thrown into the fire-box, the cold material reduces for a time part of the fire-box below the igniting temperature, and the gases distilled by the hot fire beneath are ruined by the cold place they have to go through above, and they pass into the flues in the shape of worthless smoke and coal gas. The fire-box sheets abstract the heat so quickly that waste will occur from the fuel close to the sheets or the gases passing up beside them getting below the igniting temperature, unless the fireman watches to see that a bright fire is kept up in the vicinity of the sheets.

BURNING ANTHRACITE COAL.

Thus far we have considered principally the conditions met with in burning carbon alone, such as may be encountered in burning coke, or in the firing of anthracite coal burning engines. Anthracite burns more slowly than bituminous coal, and consequently a larger grate area has to be provided, in order that sufficient coal may be burned to keep up the steam required. As cylinders of a given size draw from the boiler the same volume of steam per minute, no matter what kind of coal is used, and as soft coal which burns freely produces about the same quantity of steam per pound consumed as anthracite which burns slowly, means must be devised to make the hard coal burning engine consume the same quantity per minute as the other, and no better way has been found than that of making a large fire-box.

Anthracite coal has to be fired to suit the size of the lumps used. If the coal is in coarse lumps weighing in the neighborhood of eight pounds each, a thick fire must be carried, for the lumps lie so open that the air would pass so freely through that it would chill the fire-box. A thin fire of this kind of coal can not be carried in a locomotive furnace, for the same reason that you cannot keep a fire burning in a small stove with three or four big lumps of hard coal. In firing lump coal of large size, even when a thick fire is carried, constant care has to be exercised to prevent loss of heat from excessive quantities of air passing through holes. There is a constant tendency for air passages to form close to the sheets, and good firemen provide against this by keeping the fire heavier close to the sheets than at other parts. When too much air is admitted through the fire, the tendency is to reduce parts of the fire-box below the igniting temperature with the results already mentioned.

Firing with large lumps is wasteful both with anthracite and bituminous coal.

When the smaller broken qualities of anthracite coal are used, a very large grate area is necessary, because the fire must be burned thin, and a thin fire will not stand the action of a sharp exhaust unless the blast is divided over a wide area. The man who makes a highly successful fireman of hard coal, whether it be in lumps or of small quality, is constantly on the lookout for spots where an over supply of air is beginning to work through, and he promptly checks this by applying fresh coal at the proper point.

BURNING BITUMINOUS COAL.

The burning of bituminous coal is a much more complex operation than that of burning anthracite. The volatile gases in this kind of coal contain great heat generating power; but they are difficult to burn so that none of the heating elements will be lost. Average bituminous coal contains 65 per cent. of carbon and 25 per cent. of hydro-carbons. About ⅛ by weight of the latter is hydrogen gas, which makes the hottest fire that can be burned; but it ignites only at a very high temperature, as has been alluded to, and if the fire-box or any part of it gets cooler than this, all or a part of the gas passes away unconsumed. In that case there is direct loss by the gas not being used to create heat, and also loss due to the work done by the burning carbon in gasifying the hydro-carbons. To turn a solid into a gas uses up heat in the same way that evaporating water into steam does.

To burn, hydrogen gas unites in the proportion of two parts by weight (two atoms) to sixteen parts by weight of oxygen (one atom), and the product is water. It may appear strange that water is formed by the burning of a fire, but such is the case, and a tremendous heat is evolved by the operation. The water passes away in the form of colorless steam; but when it touches a cool place the vapor instantly condenses into water. When a fire is newly lighted in the boiler of a locomotive the drops of water that may be seen oozing out of the smoke-box joints is the water formed from the hydrogen of the fuel.

HEAT VALUE OF THE VOLATILE GASES.

The combustion of each pound of hydrogen gas, if it combines with eight pounds of oxygen taken from the air, produces about 50,000 heat units, or enough to raise 294 pounds of water from the tank temperature to the boiling point. It will be noted that one pound of hydrogen calls for eight pounds of oxygen (2 to 16) for perfect combustion, while each pound of carbon requires only 2⅔ pounds of oxygen (12 to 32). As the hydro-carbon gases are released at the top of the fire it is difficult getting this very large volume of air needed for combustion to the proper place unless means are taken for admitting air above the fire.

HEAT LOSSES THAT RESULT FROM BAD FIRING.

Our engine is laboring along with a heavy, thick fire on the grates. The air that passes up into the fire has the atoms of oxygen seized on by the glowing carbon first encountered, and the heat generated keeps distilling the hydro carbon gas from the green coal above. There being no means of admitting air above the fire, and there being very little oxygen left in the air after it worked up through the body of the burning fuel, the volatile gases fail to receive their supply of oxygen, and with their great steam-making possibilities, they pass away in the form of worthless smoke and unconsumed coal gas. The fire being so thick and compact that the air cannot diffuse freely through the mass, a considerable part of the solid carbon does not receive its full share of oxygen, so it passes away in the inferior heating condition of carbonic oxide.

An inferior fireman, who maintains a thick fire, will often use up an enormous quantity of coal without making an engine steam freely. This is caused by the air failing to reach the 25 per cent. of the fuel that exists as hydro-carbons, and which are in consequence utterly wasted; and because part of the solid carbon is burned to carbonic *oxide*, which produces 4,500 heat units, as compared with 14,500 heat units that would result from the carbon being consumed as carbonic *acid*. A fire run in this wasteful manner is always smoky, and the fire-box looks dull and cloudy, with a tendency for the sheets to hold a covering of soot.

EFFECT OF SMALL NOZZLES.

Quick, heavy firing, with all the losses described, is not always caused by ignorance or want of skill on the part of the fireman. It is very frequently the case that an engine will not steam freely unless a heavy fire is carried. This state of things is nearly always due to the use of very small nozzles, which make the blast so sharp that a thin fire could not be used, as the fierce rush of air would be constantly tearing holes in places through which the cold air would pass directly into the flues. When an engine does not steam freely, the tendency always is to call for smaller nozzles; yet it often happens that the nozzles are already too small for free steaming. The diverse character of the coal supplied on most roads is responsible for great waste of fuel. With the average coal an engine will steam while using a large nozzle. But occasionally some cars of coal will be sent in that contains a large percentage of slate and other incombustible material. When an engine gets a tenderful of this stuff, there will be trouble in making steam freely enough to take the train along on time. The men know that a sharp blast would help them in such a case, and it is natural that they should be ready to provide all the time against this emergency.

DEFECTS OF LOCOMOTIVE DESIGNING.

The mistakes and prejudices of enginemen often lead to the use of extravagantly small nozzles; but what in most cases makes the use of small nozzles necessary is badly proportioned locomotives. When the cylinders are too large for the boiler, or where the fire-box is badly proportioned, the defect must be overcome by employing small nozzles.

For burning bituminous coal economically, means should be provided for admitting a limited supply of air above the fire, the same to be under control of the fireman. The dampers should also be so constructed that the supply of air through the grates could be regulated to suit the needs of the fire. A light fire could often be carried if the fireman could restrict the air to the exact volume wanted. If greater attention were directed to this part of locomotive construction, firemen would feel more encouraged to find out what supply of air best suited a fire for the economical combustion of coal.

ORDINARY FIRING.

Suppose the engine we are dealing with has the best devised and well-adjusted draft appliances, and it is practicable to carry a medium light fire, even when doing fairly heavy work. When the fireman throws a shovelful of coal upon the fire, the effect is similar to that of pouring a dipperful of cold water into a boiling kettle, it reduces the temperature of the fire-box. A small quantity of cold water does not check the boiling of a kettle much, and one or two shovelfuls of coal is little felt on a big bright fire. When the coal newly thrown into the fire-box strikes the incandescent fire, part of the heat of the latter is absorbed raising the temperature of the fresh fuel to the igniting point. This takes just an instant, and the hydro-carbons of the coal are released. If the necessary oxygen is present the gases combine and give forth the intense heat due to their perfect combustion. When the fire is kept thin, and firing is done at frequent intervals, the hydro-carbons are fairly well utilized, and the engine steams well with a small supply of coal, and there is little smoke produced. If, instead of throwing one or two shovelfuls of coal into the fire at one time, the fireman throws in ten or a dozen shovelfuls, the great mass of cold coal reduces the surface of the fire below the igniting temperature of gas, and all the gases of the fresh coal that are expelled by the hot fire beneath pass through the flues without doing any good. And the heat of the bright burning coal that has been expended turning the green coal into gas is wasted.

The most common way of firing soft coal engines is to carry as heavy a fire as the engine will steam with. At each firing six or seven shovelfuls of coal are thrown into the fire-box. When the door is closed a stream of black smoke keeps pouring out of the stack, which tells that the hydro-carbons of the fuel are passing away without being burned, a source of heat loss due to the want of oxygen at the point where the gases are distilled, or through spots of the fire being below the igniting temperature. The fireman watches the smoke stack, and as soon as he finds the current of smoke begins to get clear he concludes that it is time to begin firing again, so he pitches in another heavy charge of green coal, and the blackness of the smoke is kept up.

In most cases this method of firing is pursued because it requires the least amount of personal exertion and attention. More coal is burned than would be used with good, skillful firing, but very little attention has to be bestowed upon the work done.

Firemen who are anxious to do their work well, and who know something about what good firing means, keep up steam after a different method. They keep sufficient fire on the grates to suit the way the engine is working, and enough to prevent loss from air passing up so freely as to reduce the temperature of the fire-box. They keep up the fire by throwing in a shovelful or two of coal at short intervals; and the result is that the greater portion of the hydro-carbon gases is burned and very little smoke is seen issuing from the stack. This style of firing is the way to make steam with the least possible consumption of coal, and a man who follows the practice does his work in a first-class workmanlike manner.

A Boiler That Was Hard to Fill.

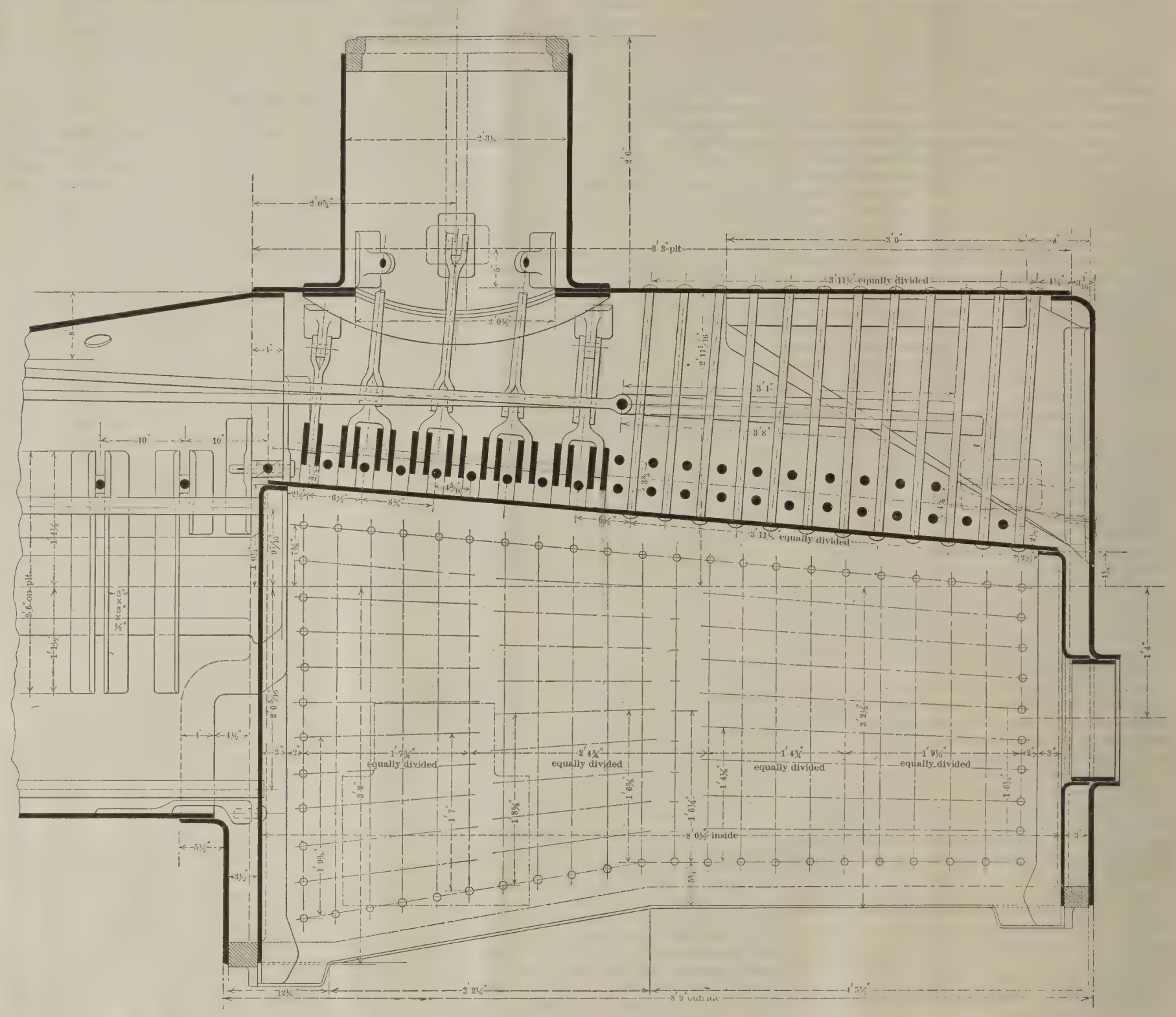
While talking about the peculiarities of locomotives, and the mysterious disorders they are subject to, which make some unthinking people believe that these machines have moods of good and bad behavior, Mr. James Donnelly, superintendent of the Lehigh Valley Railroad recently gave several pointed illustrations. He said, years ago, before the days of injectors, we were dreadfully hard up for power, and it was necessary to keep engines in service when they were really unfit for work. The old "Susquehanna" was a terror to the boys for some months on account of the quantity of water she could get away with. When she was in the house at night, the pump was kept disconnected, and it was the business of Sam Rawlins and Joe Pearce to keep water in the boiler by working the pump by hand. One night they were toiling very hard at the pump, and every few minutes the water gauge cocks were tried, but the water in the boiler kept dropping down, for the side sheets and crown sheets and flues and corners of the fire-box were all leaking.

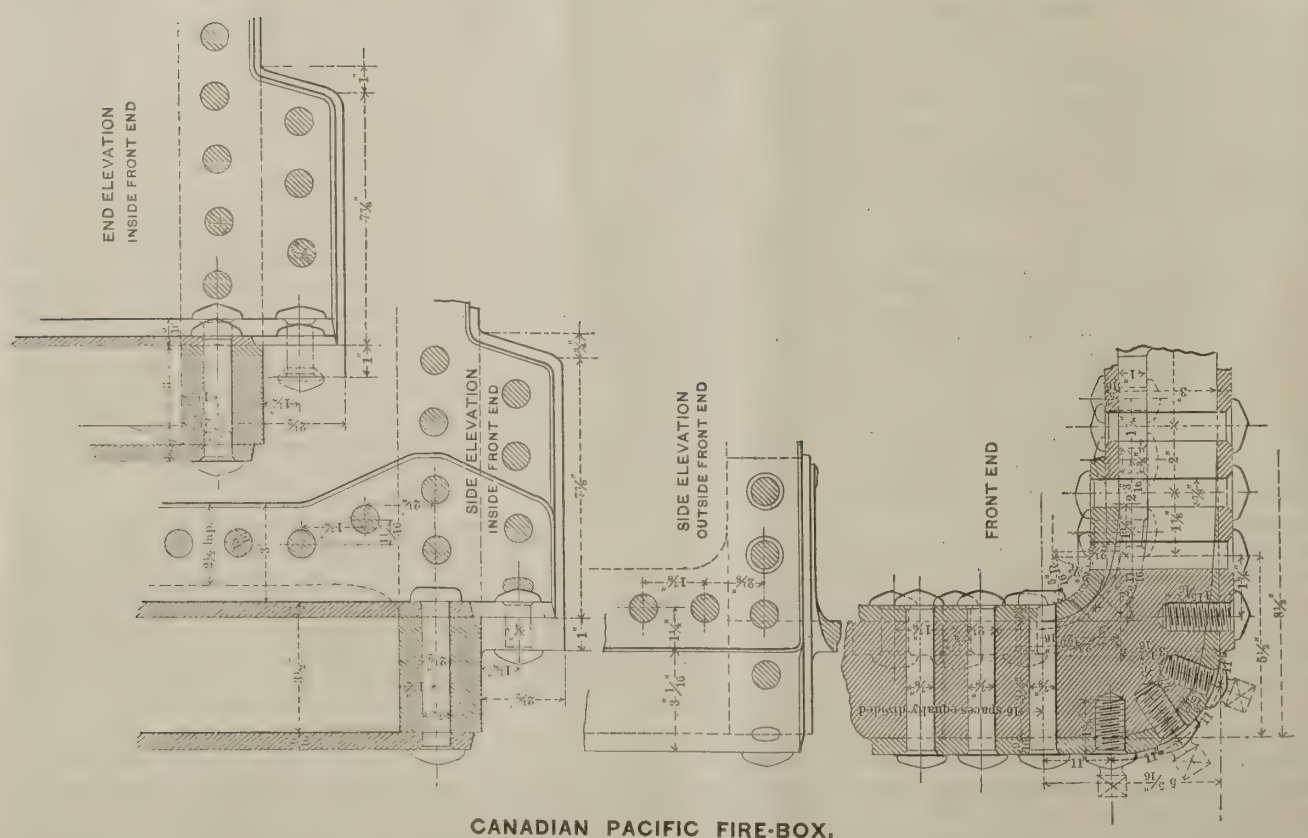
Sam kept cussing the old engine and snarling at Joe, his assistant, for not making that pump jerk a little faster, but they both kept at it pretty steady, sweating and fuming till the water was out of the lower gauge, then they dumped the fire and Joe was sent off to call Mr. Howard, the master mechanic, and tell him that there would be no engine for No. 8 in the morning. Mr. Howard got up and went right over to the engine house, as many another officer holding the same position has had to do in the middle of the night when scrap motive power has to be cared for. He looked the engine over and did not think the fire-box was leaking any worse than usual, so he started the men on the pump again. On feeling the check he found they were not putting any water in, so he ordered the hose to be examined. It was all clear but the tender was empty. The men had been wrestling all night to fill a boiler from an empty tank.

A local architect proposed to heat the storerooms of the Canadian Locomotive Works by steam with the overhead arrangement of piping. The storekeeper, who was a ready-witted Irishman, on hearing a description of the plans, exclaimed, "Do you mane to hang the pipes up there?" pointing to the ceiling. "Och, ye's might as well tell me to put on my fur cap on my head to warm my fate."

One of the locomotives recently built for the Strong Locomotive Company is at work on the Susquehanna division of the Erie, and is reported to be doing good work in handling heavy fast passenger trains with economy and dispatch.

The Burton Stock Car Co. are very busy. Among their recent orders are a number of their improved stock cars 36 feet long for the Chicago, Rock Island & Pacific R. R., and they are also building 250 horse cars 44 feet long, with Monitor roofs, Miller platforms and M. C. B. standard trucks and equipped with air brakes. Their plant at Wichita, Kan., covers 27 acres, and they employ 300 men.





CANADIAN PACIFIC FIRE-BOX.

The annexed engravings illustrate the construction of a fire-box designed by Mr. F. R. F. Brown, mechanical superintendent of the Canadian Pacific, and largely used for heavy locomotives where a more liberal grate surface is necessary than what can be got when the mud ring is down between the frames. The general style of the box is so obvious from the cuts that no detailed description is necessary. We would, however, direct attention to the method of making the bottom corners of the fire-box shown in Fig. 2. It will be seen that the method of fastening the corners of the sheets to the mud ring is very well worked out, and the extending of part of the sheets far enough down to rivet beneath the mud ring secures a very strong corner and prevents the movement that so often causes leakage in a point particularly difficult to reach.

American Freight Cars in England.

With the object of inaugurating a new industry at Barrow in the building of what are known as American freight cars, two of Goodfellow & Cushman's freight cars have been brought over from the United States in sections, and after being built up at London were taken to Barrow recently, where they were loaded and severely tested. These wagons are each 30 feet long and will carry 30 tons. The frame is built of steel tubes bound with steel struts. The car is supported at each end by a bogie, something similar to those seen under the carriages of the Midland Railway Company. The wheels, which are of cast steel, and of which there are four to each bogie, are cast in a block and without the usual tire. The carrying capacity for an ordinary English railway wagon is 10 tons, though the length of the wagon is just half that of the American freight car. One of the cars was loaded with 30 tons of steel rails and the other with about 27 tons of coal. Several trips were made to the steel works and in the goods yard, and the cars were found to answer admirably.

It is claimed for the Goodfellow & Cushman steel tube light weight freight cars that a larger amount of goods could be carried than with the present wagons, and that there would be a saving of time, labor and money, and it is urged by many who have studied the question that the English railway will before long be compelled to adopt some such wagon. One advantage to these cars is that, although 30 ft. in length and capable of carrying 30 tons, their weight is only 10 tons, whereas an English wagon carrying a load of 10 tons weighs on an average about 6 tons. It is urged, on the other hand, that the car by its mode of construction is really a stronger wagon, though it is comparatively much lighter. Mr. H. Roberts, of the carriage and wagon department of the Midland Railway, at Bristol, is an advocate for the adoption of cars similar to those under notice. He says he does not advocate the destruction of existing stock of goods, but thinks that all renewals of worn-out stock should be on the principle of greater length and greater carrying capacity. —*Colliery Guardian.*

Steam Heat for Railway Trains.

At the January meeting of the Western Railway Club, Mr. J. H. Setchel read a paper on the above subject. He mentioned that he called on a general manager of a prominent road to talk about heating cars with steam, and was informed that his hearer did not believe in steam heating, although he admitted that 2 per cent. of the persons killed in railroad accidents lost their lives through fires started by stoves. Mr. Setchel said that when any parts of railway appliances were so defective as to cause fatal accidents, every effort was made to strengthen them, and on the same principle it was the duty of railroad managers to stop the loss of life represented by the two per cent. burned up in fires.

One of the trunk lines has 700 cars heated with steam, and the system requires no more attention than air brakes, and heats the cars satisfactorily. The drain on the locomotive is not felt any more than the drain that is necessary to keep the air pump working.

The fact is, that the variations in the requirements of the locomotives are so great that the matter of warming the train and running the air brake may truthfully be said to not cut any figure in the fuel account. For instance, I said to the engineer running a fast train out of the city of Chicago, as he was about starting on a trip of a 100-mile run a few days since, "If you were called upon to make up twenty minutes on this run how much extra fuel would your engine consume in doing it?" He replied, without any hesitation, "It will take two extra tubes of coal of 1,250 pounds each, or about 2,500 pounds more." Thus we see how important it is that the trains should be kept on time to secure uniform results, and it also shows how hard it would be, with such an extreme variation, to find the coal consumed in warming the train or running the air brake. As another evidence, the engineer above quoted informed me that with his train he ran 59 miles for water, and in order to be sure of getting there it was the practice of engineers on this train to start with a full boiler of water and a full tank. This was before steam was used on the train, "and now," he continued, "we heat the train and get there just the same." With this brief, superficial examination of the subject, we see that continuous steam heat is practical and at the same time economical, and entirely safe from any danger to the traveling public, and there would seem to be no good reason why it should not be adopted.

Mr. W. S. Johnson read a paper on "The Essential Elements of Steam Heating." He held these to be the coupling, the drainage of pipes and the trap. If these were properly designed and carefully attended to there was no more difficulty in heating cars than there is in heating houses. His conclusions were, that ultimately steam heating of railway trains will be a very simple affair; that many of the contrivances now being used will be discarded, and that we will come down to plain pipes with plain valves, and as few of both as possible. Couplings will be so arranged that they will not pocket water; train pipes will be drained at least in one point in every car. Expansion traps will be discarded and some form of periodic trap will be substituted in their place. There is no reason why trains should not be steam heated without any annoyances. There is no reason why a train when coupled up in the yards should not make the complete trip without any attention to the steam heating whatever. There is no reason why a coupling cannot be steam tight for weeks or months without attention. There is no reason why a trap cannot be made that needs no adjustment from day to day, nor from month to month. Unless a system of steam heating is as complete as the above, it cannot in the long run be successful. Any system of heating that needs to be babied or tinkered with every day or every week cannot be a success. Instead of adding to the duties of the trainmen, the adoption of steam heating should reduce their duties, as it should work automatically and relieve them from the attention which they usually give to the stove.

Mr. Martin spoke of the successful working of the system which bears his name and the small amount of trouble experienced with condensation of water in the pipes. He said, I have known men who are up on experimental tests to put the question, why is it that there is no more condensation of the steam as it enters the eighth or ninth car than there is in the first or second? There is in the steam a large amount of latent heat, and as you pass that steam along those units of heat will continue to reveal themselves. Take a train of eight or ten cars, and suddenly break two of the couplings, and what is the result? You will not get a tea cup full of water. With the system that I represent I always insist that when the cars go out of service they shall always uncouple them, because of the liability to freeze. In the face of that fact the New York Central make a practice of letting their trains stand without uncoupling them. They say, "Never mind what your rules are, our experience is enough for us. We don't uncouple those cars if our trains are going out the next morning." In investigating this subject we found that until we put it in service there had never been a train heated where they retained the dry steam in the main pipe. They would either go into one pipe and out and into another, carrying the condensation, or else they would made a circuit of the pipe and a portion of the condensation, if not all of it, would be carried into the main pipe and swept back into the next car. The result was that they found they could not heat more than four or five cars. A gentleman told me that while he could get five gallons out of the first car he could get twenty out of the last one. The result is, the temperature of your steam is reduced. We must transmit dry steam as far as it can be done to the rear end of the train, and not allow any of that water that is condensed to go back into the main pipe; the moment you do that you destroy the efficiency of your system. We intend to try and convince the railroads that it is profitable to have some one who is willing to spend his means and brains to gather up and utilize that which will make the most perfect system in its simplicity and utility, crystallizing the ideas of the railway mechanics of the country into a system that will be entirely satisfactory to the railroads. I think a great many are looking at it in that way, and are gradually gravitating towards it.

Mr. W. F. Turreff, C., C., C. & I., has been using the Martin system for several years and finds no annoyance from traps freezing. We have a school where the trainmen, brakemen and conductors are brought in to manipulate the system, and in that way they become very familiar and proficient with it. We are very well satisfied with the system.

Mr. Schroyer, Chicago & Northwestern: We have encountered some difficulties in steam-heating, and we are honest enough to look those difficulties right straight in the face and acknowledge them, and try to overcome them. I consider that there is a great deal in the manner in which a car is piped. I think it should be piped so that the condensation shall flow towards a certain point, but you must acknowledge that you cannot get much of an incline. One of the difficulties we have experienced in the use of a live steam device is that at certain points the condensation takes place very rapidly, and in some places we don't get heat enough to keep it comfortably warm, while in other parts of the car we get more heat than we know what to do with. You may say that we could overcome that by taking out pipes in one place and adding at another, but we do not consider that we can do that. If we take out some of the piping we shall not get enough heat when we use the emergency heater, which we have to do at certain times. We are unable to clean our cars unless they are warm, and to warm them we have to put in a stove, or else put in a Baker heater. Regarding the manner of piping the car I maintain that that is one of the essential points. I have put along the truss plank a two-inch radiator pipe inclining towards a certain point, and I have found that it heats up along the truss planking, so that it is uncomfortably warm, but persons sitting away from there don't get enough heat, and in order to overcome that we have to run pipes under the seats. We find that if the switchmen will open the blow-off trap there will be no trouble regarding the condensation being blown out of these pipes.

The discussion was further participated in by Messrs. Hickey, Rhodes and Scheets, and certain difficulties in regulating details of steam heating were ventilated.

Journal Bearings.

At the January meeting of the Western Railway Club, Mr. F. J. Bennett read a paper entitled "Can there be an anti-frictional metal made for journal bearings to prevent the heating of them under ordinary circumstances?" The question raised by the title of the paper was answered in the affirmative and then the author proceeded to illustrate the irregularity in the wearing qualities of bearings when subjected to what appeared to be the same service. Considerable statistical data were given showing the wearing qualities of different metals lubricated in different ways.

Mr. Scheets, a manufacturer of journal bearings, held that a metal could be produced which would reduce the heating of journals, but that no absolutely anti-frictional metal could be made. Insisted that the use of inferior metal bearings was very expensive in the end to railroad companies.

Mr. J. H. Setchel agreed that it was best to use the best material for bearings. Found that good brass bearings when properly cleaned could be put in service successfully if strips of babbit were put on the face so that the brass could wear gradually to a bearing. Trouble with bearings was often due to the inferior material of the journal when muck bar axles were used.

Mr. F. W. Sargent, engineer of tests C., B. & Q., had made experiments as to the difference between a hard bearing point as against some of the softer mixtures, and he said I have here the results of tests made with three different materials as bearing surfaces. I will call them A, B and C, of which A represents one of the hardest in the market, B another hard bearing and C is a representative of a soft bearing. With A I got a co-efficient of friction of .0028, with B .0030, and with C of .0049. Rating their value as anti-frictional metals, I have for A 100, B 95 and C 53. In another test of the same I got for A an anti frictional value of 100, B 97 and C 50. In other words I got the least friction with the hardest surface, the hardest bearing. These bearings had all been worn down so that the tests were made under the same conditions. The tests were made with the bearing surfaces as perfect as could be made, and also on a very finely polished steel journal, and they seemed to show conclusively that where the conditions of both journal and bearings are true the friction is at the minimum with the hardest material.

President Rhodes: During the recent brake tests we made a number of train resistance tests, and it was found that with three trains, one composed of C., B. & Q. cars, another of Illinois Central cars, and the third of Pennsylvania Railroad cars, there was a marked difference in the train resistance. Just what brought the different resistance of the different trains is questionable, but there is one curious fact about it, that the Pennsylvania train had very hard bearings, the Illinois Central had a bearing all babbit lined, and the C., B. & Q train was lead lined. The differences in the train resistance between these three trains were that the Pennsylvania showed a resistance per ton of 2,000 pounds of 5.87, the Illinois Central 6.22, and the C., B. & Q. 7.51. Another train, which was composed of St. Joseph and St Louis cars, showed a train resistance of 12 pounds. I cite this latter case, because we worked out that 12-pound resistance to show the difference between it as against a 5.87. It meant that the train with the 12-pound resistance per ton had a grade of 20 feet per mile as against the smaller resistance. That brings up this question, that when the railroad companies are straightening out the tracks and cutting down the grades, they must look after the motive power department, where they may be raising a grade of 5 or 10 feet. To give an idea of the difference in hauling of the train with a resistance per ton of 5.87 as against 7.51, I find from the brake report that this difference, insignificant as it would appear, would in running a thousand miles necessitate an extra amount of haulage power, equivalent to surmounting summits 4,330 and 3,415 feet high respectively, or greater than that of any line between the Mississippi and the Atlantic.

Mr. Sargent: I found in making these experiments that I referred to, that everything depended upon the amount of oil in the journal. I understand that at the brake tests the Pennsylvania Road, with the hard bearing, had the boxes filled up completely with oil, whereas on the other cars they had waste and oil. At any rate the Pennsylvania axles were much better lubricated than any of the others. I noticed also in my tests that the rate of heating with the softer bearings was about 70 per cent. greater than that of the hard bearings.

Mr. J. N. Barr, Chicago, Milwaukee & St. Paul: Our practice is to use a brass shell, lined with a mixture of lead and antimony We use the same oil that we did three years ago. We have had this practice in general use for probably two years, and the hot bearing record would indicate that we have not over half so many hot bearings at present as we had two years ago, with a very material reduction in the consumption of oil, the same oil being used during the entire period. I think that a test with a mechanically perfect bearing, with a mechanically perfect axle and thorough lubrication, throws very little light on what you may expect in actual practice. We never have those circumstances. We haven't a perfect journal, nor a perfect fitting bearing, and we are sometimes a little slack of oil, and we have more or less dirt and grit to contend with. All these points have to be taken into consideration, and these points have conspired together to make us feel satisfied that a soft bearing gives the best general results. Of course this matter of bearings is a complicated question, as it involves a consideration of the consumption of oil, the consumption of waste and the wearing of journals.

It is difficult to reach a definite conclusion on it, but I believe that, taking the general practice of railroads into consideration, the necessity of getting trains over the road on time, the requirements of the transportation department, that a soft bearing is going to see you to the end better and cheaper and safer than a hard bearing. At the same time I do not feel at all inclined to deny that a hard bearing, with a properly fitting journal, will give you better theoretical results than anything soft. I have paid considerable attention to this matter, at one time placing hard bearings on one journal and a soft bearing on the other. I found that the hardest bearing decreased in weight the fastest, also that the softest bearing reduced the axle in diameter at a considerably greater rate than the hard bearing.

Mr. B. K. Verbryck, C., R. I. & P., used to advocate hard bearings, but experience had convinced him that soft bearings ran better, and were easier on journals. For freight service he prefers common brass.

Mr. John Hickey, Milwaukee, Lake Shore & Western, believed that when a journal was new a hard bearing was best for it, but when it became worn out of shape a soft lined brass would prevent its running hot. Believed it was their duty to search for the metal that would run with the least amount of friction.

Mr. Schroyer (Chicago & Northwestern): They use a brass shell filled with babbit metal composed of about 80 per cent. of tin and 20 per cent. of antimony, with a little plumbago. For lubricating their passenger equipment they use a paste which gives better results than the oil did that was formerly used, but it is by no means perfect. They use oil for freight cars.

President Rhodes: A four-wheel truck baggage car that passed over the C., B. & Q. was constantly getting hot journals, and they found there was a pressure per square inch on the journal of 420 pounds. Our practice with baggage cars, when they exceed a pressure of 350 pounds per square inch, is to put in six-wheel trucks. Mr. Hickey says that in some previous discussion here it was considered that about 300 pounds pressure per square inch was about all it was safe to carry to prevent hot boxes. Now the 60,000-pound cars which are now being built, when loaded to their full capacity on their 4 × 8 journals, have a pressure of 352 pounds per square inch. The old Master Car-Builders' 7 × 3¾, when loaded to 40,000 pounds capacity, had 312 pounds, and it would seem as though in considering this bearing question we must also consider the additional load that we are now asking our bearings to carry.

Social Meeting of Central Railroad Club.

The annual meeting for election of officers of this club was due on January 23 and the members determined to add a little pleasure to business. They accordingly sent out invitations to the members of other railroad clubs and other friends to be present in the Tifft House, Buffalo, and join the members of the Central Club round the festive board. A goodly number responded and a highly enjoyable day was spent, club business, discussion of railroad matters, discussing of the good things of this life, carriage riding, watching of car coupler tests, toasts, wine, speechmaking and promiscuous hilarity being the varieties of entertainment.

The meeting was called to order at eleven o'clock by Mr. John W. Cloud, and the first business taken up was the election of officers. The selection made was: For President, E. Chamberlain, Master Car-Builder, New York Central & Hudson River, Buffalo; Vice-President, A. C. Robson, Master Car Builder, Lake Shore & Michigan Southern, Buffalo; Secretary, F. B. Griffith, Master Mechanic, Delaware, Lackawanna & Western, Buffalo. The Executive Committee elected are: T. A. Bissell, Manager Wagner Car Works, Buffalo, chairman; E. Chamberlain; James McBeth, Master Mechanic, West Shore; Peter Smith, Master Car-Builder, New York Central, Rochester; F. D. Adams, Master Car-Builder, Boston & Albany, Boston; James R. Petrie, joint inspector, Black Rock; Richard Donaby, foreman car repairs, Niagara Falls.

A change was made in the constitution, admitting to membership persons interested in railroad matters, though not officers in charge of rolling stock or of the repairs of the same. A lengthened discussion on matters connected with the interchange of cars took place, in which Messrs. F. D. Adams, James R. Petrie, John W. Cloud, T. A. Bissell, F. B. Griffith, A. C. Robson, J. D. McIlvain and E. Chamberlain participated. Nearly all the speakers favored liberal interpretation of the Rules of Interchange, and there was a general desire expressed to see less quibbling about trifling defects that often leads to the delay of cars.

The club is in a highly flourishing condition. Its new financier, Mr. F. B. Griffith, has inherited a most elastic treasury. The members have been assessed $2 each in three years and it is understood that sufficient money has accumulated after paying all current expenses to defray the cost of the banquet given to the members and their friends. More than one man who has wrestled with the finances of railroad clubs and associations is anxious to learn how this has been done, but Mr. Griffith maintains silence and the mystery grows.

We have been advised by Messrs. Long & Co., of Pittsburgh, Pa., that they have taken the general agency of the Marks Automatic Car Coupler, and that all business connected with it will be transacted at their office in the Hamilton building.

Railway Car Construction.

BY WILLIAM VOSS.

Fifth Paper.

BOX CAR SIDE DOORS.

The doors and their attachments, like many other details of our freight cars, are still in an imperfect state, notwithstanding the attention they have received from both builders and inventors, but who have so far failed to produce anything entirely satisfactory under all the varied conditions of the service.

The batten door is the oldest and cheapest, and is perhaps as strong and durable as the framed door which superseded it; but since the weak points of the latter have become better known the former is again much used, perhaps as much as the other. The construction of the batten door is very simple and generally like that in Fig. 50. The boards, which are the same as those used for the siding, are clinch nailed to three or more battens of $\frac{7}{8}$-inch pine from 6 to 8 inches wide. Upright pieces of the same material fill the spaces between these on the edges. Braces are sometimes fitted in the lower space to better preserve the rectangular form.

The framed door consists of a hard wood frame, to which a panel or filling of sheathing is secured with nails or screws. The lumber used for the frame is ash, which is not as durable and more costly than oak, but is selected because the other will not stay in shape, and the distortion seriously interferes with the free working of the door. The stiles and top rail of $1\frac{3}{4} \times 6$ inches and the bottom rail of $1\frac{3}{4} \times 7$ inches are put together with a mortise and tenon, and a half-inch joint bolt at each corner. One or more middle rails of the same width as the top rail and stiles, but usually not more than seven-eighths of an inch thick, are framed to the stiles in the same manner, but as they are too thin to admit of a joint bolt, a three-eighth inch rod is substituted. The panel is fitted to rabbets cut in the edges of the stiles and rails, and in Fig. 51 is placed flush with the inside of the frame. This makes the strongest door and the neatest in appearance, but one that also decays very rapidly, the protruding edges of the rails holding the water, allow that to lodge in the joints. To avoid this the panel can be and frequently is placed flush with the exterior, as in Fig. 52. The boards composing the panel must in this case be securely fastened, preferably with screws, as they are readily displaced from contact with the load, when the grain doors are not down or the car is not supplied with the latter. By framing the bottom rail similar to the middle rails, and like that shown in Fig. 53, a construction lately introduced, this difficulty is to a great extent overcome, and the joints also more perfectly protected against rain.

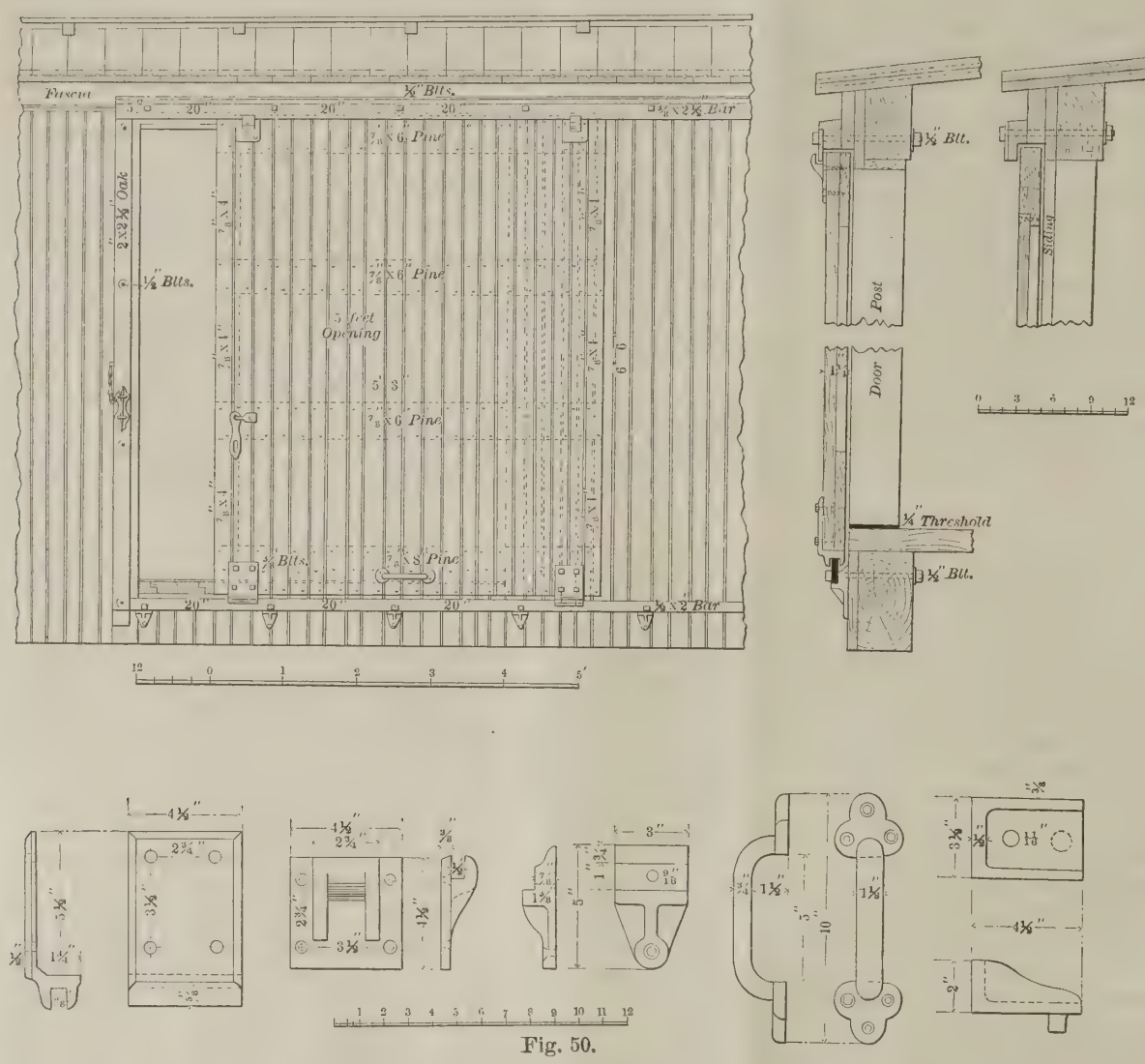


Fig. 50.

Fig. 51.

Fig. 52.

Fig. 53.

Fig. 54.

blocked out one inch from the side of the car with seven cast-iron brackets, and is fastened with the same number of $\frac{1}{2}$-inch bolts passing through the bar and brackets, with the nuts preferably on the inside of the side sill. On this track the door slides by means of two cast-iron shoes, each secured to it with four $\frac{5}{8}$-inch bolts, with square or oval heads let in flush with the inside face of the door. The groove in the lower extremity of the shoe should be fully $\frac{5}{8}$ of an inch deep, and the same in width to prevent cramping if the track be accidentally bent. The door may be guided at the top by a hard wood strip or cap rabbeted on its lower edge to fit over and hold the door, as shown in one of the cross-sections. A stronger cap and one that offers less resistance to the moving of the door is shown in the other cross-section and also in the elevation. A strap of iron somewhat lighter than that used for the track is supported at the proper distance from the car by a strip of pine lumber and seven $\frac{1}{2}$ inch bolts extending through the fascia, sheathing and side plate. Cast-iron guides designed to engage with this bar are screwed one to each upper corner of the door, which is by them prevented from coming in contact with both the guide bar and the side of the car. The bulging of the door, caused from swelling of the boards, which is one of the objectionable features of the batten door, is also provided for in this arrangement, a clear space of $\frac{3}{8}$ of an inch being left between the door and bar. A cast, malleable cast or wrought-iron handle for operating the door is attached usually at the center of the bottom rail. The door is prevented from opening too far and from running off the track by a stop of wood or cast iron fastened to the side of the car with one or two $\frac{1}{2} \times 3\frac{1}{2}$-inch lag screws extending through the siding and into the girth, or into one of the posts or braces, if these happen to be in a convenient place. This stop and one of the brackets can be dispensed with, if the end of the track is turned in and

The doors are made to slide on the outside of the car, and with very few exceptions open to the right. The many different methods employed to accomplish this may be divided in two general classes, the one including all those by which the door is supported at the bottom and the other those supporting it from the top.

The ordinary form of attachment in the former case is shown in Fig. 50. The track, a bar of $\frac{1}{2} \times 2$ inches wrought iron of a length equal to the width of the door, plus the opening, which is usually five feet, is bolted to the car direct. The door fastenings consist of a hasp, staple and pin made in a variety of forms, and either of malleable, cast or wrought iron. They should be of ample size, and securely fastened with bolts in such a manner that they can not be tampered with. The pin has a circular or oblong perforation near its point, through which a wire or tin strip attached to the seal is inserted. The cast-iron shoes, brackets and stops are also shown in detail; they, as well as the other parts of the attachment, may not be of the best proportions possible, as it is difficult

to select from the numberless variety, every road following some notion in regard to their patterns, sizes and number of pieces required ; but these will not differ much in the essentials from the majority of those in use.

The attachment shown in Fig. 51 is the one commonly used when the door is suspended. A track similar in dimension and fastening to that described in the preceding is placed immediately above and flush with the door. Cast-iron thimbles at each bolt or a strip of wood extending the full length of the track are used in place of the brackets, the heads of the bolts being counter sunk so being in the center of the end between the posts and above the girth. The usual dimensions and other details are shown in Fig. 54. The doors are constructed of the same materials, and in the same manner as those on the sides ; the apparatus for sliding them is also the same, with the difference that the dimensions of the parts are much decreased, and all special provisions to reduce friction and binding are generally omitted, the smaller size of the door making this unnecessary.

The end door is usually locked from the inside by a pin and suitable cast-iron bracket secured to the post, but a

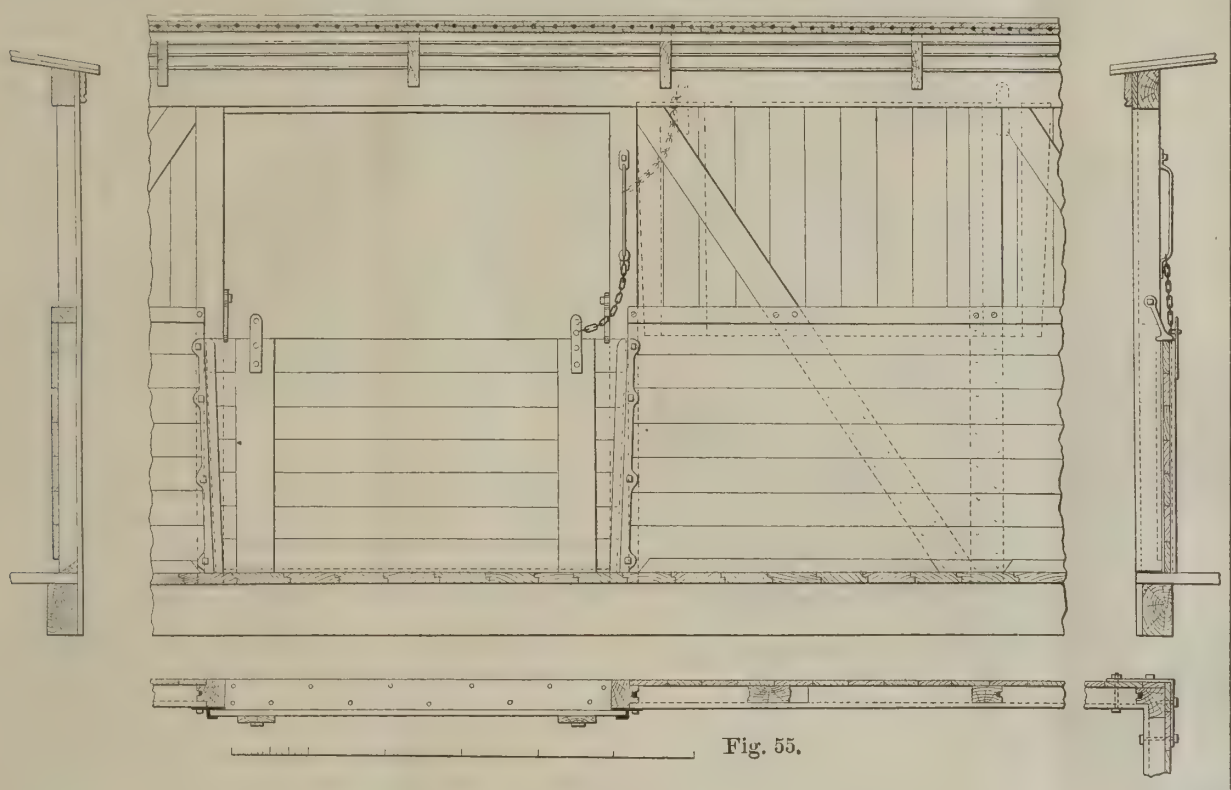


Fig. 55.

as to be out of the way of the hangers. The latter are of $\frac{5}{8} \times 2$-inch iron, forged as shown and fastened with three $\frac{1}{2}$-inch bolts each. The top edge of the door is shaped to shed the water, or has, for this purpose, a separate cap nailed to it as in the sketch. A cap is sometimes attached above the track also, but ordinarily no other protection then the projecting roof boards is provided. The lower end of the door is prevented from swinging outward by three or more cast-iron brackets so placed that at least two of them will engage with the door when it is closed. They may be constructed allowing the ordinary amount of clearance, which is from $\frac{1}{8}$ to $\frac{1}{4}$ of an inch, or with an additional space as shown, in which case a wedge chained to the door itself is inserted in a slot provided in the bracket when the door is shut, thereby more perfectly closing the opening. Another method intended to perform this automatically is shown in Fig. 52. A gravity button of cast iron or wood faced with a wrought-iron plate is hinged with a bolt or lag screw to each lower corner of the door and immediately above the bracket. This button will swing, or can be forced into place when the door is closed. The hasp, handle and stop used with this attachment are not different from those already mentioned.

The difficulty so frequently experienced in moving the doors with the ordinary attachments is chiefly due to the bulging of the side framing and consequent binding of the door; but also somewhat to the friction between the shoes or hangers and the track. The latter can be overcome by substituting anti-friction hangers, of which there is now quite a number of excellent patterns in the market. They are usually made of malleable cast-iron attached the same as those in Fig. 51, and carry a grooved wheel which travels on the ordinary iron track, or on one of a special pattern made of wood or a combination of wood and sheet metal.

A serious objection to the attachments described is the imperfect manner in which the opening is closed and the goods in transit are protected; the right-hand edge of the door, or the one not screened by the closed door stop freely admitting the driving rain and snow. To remedy this is the object of a number of patented inventions, prominent among which are the different flush-doors which are fitted to a recess at the opening and operated by means of bent tracks and pivoted shoes ; 2d, those which are forced against the side of the car when at rest by wedges fastened to the door and actuated by gravity, and 3d, those with projecting edges, similar to the check rail of an ordinary sash, used in connection with anti-friction rollers.

BOX CAR END DOORS.

Doors at the end are not essential for the bulk of the freight transported, and for that reason are omitted on a large portion of the box cars in service, but for the proper handling of a certain class of material, principally lumber, they are very convenient, and when the cars are short they are imperative.

The different locations for these doors were mentioned when describing the end-frames, the more common one hasp and staple on the outside are preferable. The door can in this case be protected by a seal the same as the side door, and the question of locating claims for shortage of freight thereby much simplified, as a seal record is usually kept at all transfer stations.

GRAIN DOORS AND LINING.

The walls of a box car are lined on the inside with matched pine boards of an inferior quality nailed to the posts and braces with horizontal seams, and extending from the floor to the girth, usually placed equi-distant from the sill and plate, but in the heavier cars much higher, the small grain finding its way through crevices and imperfections in the lining, and which in time fills the space between it and the siding, called for the construction shown in Fig. 55. The bottom edge of the lining is about 2 inches above the floor, and any matter penetrating it is projected on the floor by a three-cornered strip and through this opening.

The grain doors are a continuation of the lining across the side door openings, and should be at least of the same height. The proper manner of constructing and attaching them is one of the most perplexing problems in car construction ; and in spite of everything that has been done in this direction, they still continue to be destroyed, to be torn off their fastenings and to be lost out of all proportion to the other parts of the car.

The leading patterns are protected by patents, and are too numerous to be treated separately in this article. In one of the two classes they may be divided in, the door is made to slide up on perpendicular rods or in suitable grooves, and is stowed away under the roof when not in use. In the other class the door is pivoted to the side of the car direct or connected with it by radial bars, sliding pivots or hinges sliding on rods.

The door shown in elevation, plan and section in Fig. 55 is one of the more simple variety and is not patented. It is constructed with matched boards and battens of pine, the top and bottom boards being usually of oak, as they are more exposed to injury. Cast-iron guides attached to the inside face of the door posts with screws serve to hold the door when in position, and if made as shown also effectively prevent nailing, which the shipper seems to think is necessary and always practices unless proper precautions to prevent this have been taken. The bottom of the door rests against a threshold of $\frac{1}{4} \times 4\frac{1}{4}$ inches wrought or a heavier one of cast-iron, the former material being more suitable, as it is not so liable to fracture. No other precautions are necessary to prevent leakage of grain except the cast-iron buttons secured to the side of the door posts, which prevent the raising of the door. A cast-iron bracket or pocket, termed a lift-iron, attached on the outside near the bottom edge, serves as a purchase to a bar by which the door is opened when it is desired to do so before the car is unloaded. When not in use the door is suspended on hooks or pins provided at the side plate by staples or straps attached to its top edge. A short chain secured in such manner that it cannot be detached without breaking it or its fastenings prevents the door from being carried off.

Methods of Handling Snow.

At the January meeting of the Northwestern Railway Club, which was presided over by Mr. W. T. Small, the subject of "Snow plows and flangers" was discussed.

Mr. W. T. Reed, Chicago, St. Paul & Kansas City, believed that the rotary was the proper machine for handling snow on mountain roads; but he had found the Congdon or board plow very serviceable for prairie lines. He has extended the wings of this plow and made them movable by an air connection; he has also put rollers made out of old axles under the front of the plow where it presses on the rail when cutting through drifts. The flanger he secures beneath the bumper beam and operates it by air. With the Isaacs brooms and this combination he could handle light snow very well, but for deep cuts he would prefer the rotary. Spoke very highly of the Ellis flangers, and also commended the Priest flanger, saying it was very easy to work. Advocated putting selected men on the engines that are engaged working snow. Considered pilot plows very useful, especially on passenger engines.

Mr. W. McIntosh, Chicago & Northwestern: Flanging attachments should be arranged to cut as narrow a space in front of the wheel as possible. That is, not wider than the face of the wheel, including the flange. Snow as a rule cut out by a pilot flanging cannot be thrown out of the cut. It is simply thrown aside and packed down, and ultimately becomes as hard as ice. It is always advisable to place an experienced man in charge of any snow bucking or flanging expeditions. They should adopt such methods as will best suit the circumstances. I should expect in case of a moderate snow storm, drifts three to five feet deep, to send out our large plows attached to the locomotive, and later, as the drifts form deeper and harder, we should expect to use the rotary, and if the case required, might use the rotary in one direction and those other plows in other directions. I think if you tried the rollers under the point, just took the shoes off, you would not want to put any more shoes on. I have tried it with a chilled face, and also with the ordinary steel axle, and I found that answers better than any other. The roller is made 9 in. diam., 14 in. long, with $3\frac{1}{2}$ in. journals at each end.

Mr. S. L. Bean, Northern Pacific, believed it was time that the large "brute force" plows were done away with.

President Small, Northern Pacific, said that the practice all through the West is to rush a large number of engines into a snowbank, and then something happens, and it takes twenty-four hours before you can clear the track afterwards.

Mr. H. A. Towne, who has had much experience in handling snow, believed from what he had seen of the working of the rotary during the past winter, that it represented the principle which was the coming method of clearing away deep snow.

Mr. J. S. Leslie gave figures showing the expense of operating the Rotary Steam Snow-Shovel on the Union Pacific.

Messrs. Bean, Bardsley and McIntosh spoke of the difficulties of clearing away very hard snow with wedge plows and testified to the efficiency of the rotary.

Mr. Towne followed in the same strain, giving experiences opening the track of the Northern Pacific in years gone by. He said: Three years ago this winter I took a trip over the Santa Fe road to California, and we encountered a snow blockade at Newton, Kan. Ahead of us there were three Raymond excursion trains in the snow banks. Fortunately for them, they had their provisions with them. We remained there just one week, in Southern Kansas, where the snow rarely gets harder than the first snow that falls on the Northern Pacific. With the Northern Pacific appliances I made up my mind I could have opened that whole road in twenty-four hours. That incident will serve to illustrate my previous remarks, that the appliances adopted up here will answer for every body, whereas those in use and doing good service further south will not do here at all.

Mr. W. H. Lewis, Chicago, Burlington & Northern, also related trying experiences on the Northern Pacific in opening track that had been snowed in all winter. On one expedition, he said, we ran into a drift where the snow was from 18 to 20 feet deep. The snow had fallen early in the season, before the frost had entered into the ground, and the immense pressure forced the truck wheels against the rails so hard as to break the rails. When we pulled out, the snow ran down on the rail again, and it was not discovered. When we took the second run the point of the plow doubled under the engine. The snow was so hard that all that was necessary to do was dig down straight on the line of the engine, and the snow would hold it, as if it were on the top of a solid bank. I had a controversy one time on account of putting more power behind the plow. I had contended that the snow was so hard it was impossible for an engine to stand any more power than we were then using. To demonstrate what an engine would stand I foolishly took the plow myself, and took a run. When we struck the snow, we were going as fast as two engines could strike, and the force was so great that it sheared the tank from the frame Snow of that character, in my judgment, can better be handled with a rotary than with a wedge-shaped plow, and I think there is an economy in time as against the wedge plow. Take into account the time necessary to dig those engines out, and prepare for another run, and it is more than equivalent to running a rotary through the same depth of snow at a speed that is not faster than a man could walk. I have frequently, in running into snow 10 to 12 feet in depth, been from 35 to 50 minutes digging out the pushing engine and probably 20 minutes digging out the plow engine. That represents nearly the loss of an hour to each run taken. I think that the wedge plow can be used to advantage in snow not exceeding four feet in depth to a much greater advantage than a rotary plow, but in the snow that is encountered in this country, where it exceeds four to six feet in depth, I think there is no better way of handling it than with the rotary.

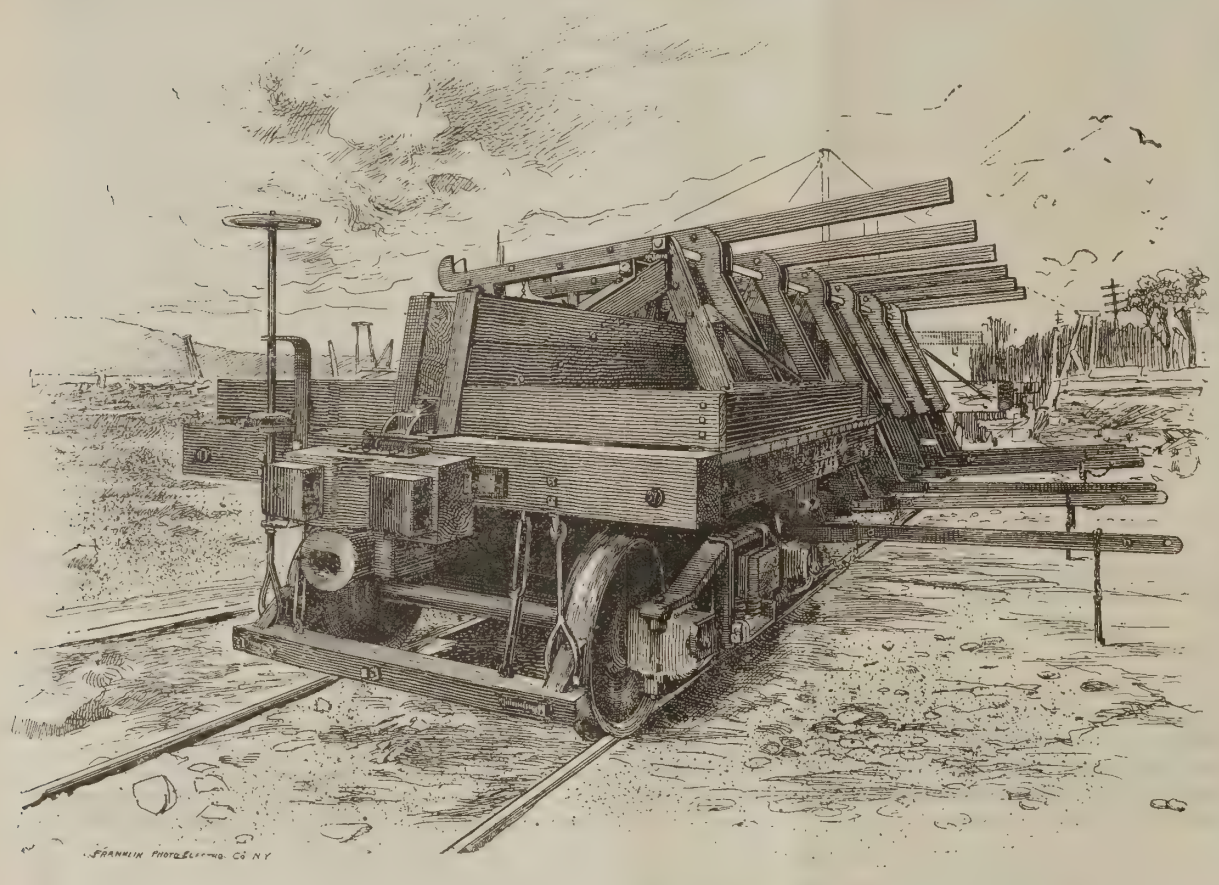
A resolution was adopted to the effect that the rotary principle was best for deep snow and the wedge plow for light snow.

The Standard Car Company has been organized in Bridgeport, Conn., to build, repair and deal in railroad equipment. The capital stock is $40,000. Goodwin Stoddard is President.

Treanor Stone Car.

The car illustrated in the annexed engravings was designed by Jas. J. Treanor, of the firm of Hurst & Treanor, blue stone dealers, to overcome one of the difficulties in the way of transporting large platforms by rail. The fact that no stone larger than 10 feet wide can be carried on a flat car made it impossible to transport in that way the large platforms which are used for sidewalks on the principal avenues of large cities, the stone extending from the curb line to the line of the stoop.

This distance is usually 15 feet 6 inches, and many stones 15 feet 6 inches, or longer, by 10 feet wide, have been brought in by rail, but as many of the stately mansions that adorn our avenues have stoops that vary in width from 10 to 20 feet between the newels, and it is always desirable to cover that space with one stone, the problem arises how to carry a stone 15 feet 6 inches wide and from 10 to 25 feet long, as occasion requires. Mr. Treanor submitted his sketches to Mr. Wm. Buchanan, superintendent of motive power of the New York Central Railroad, and under his direction the car was built by Mr. E. Chamberlain, at the New York Central car shops in East Buffalo, N. Y.



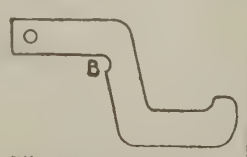
The car is built with two ordinary standard trucks set about 35 feet from center to center, the portion over each truck being framed and floored the same as a platform car. These platforms are connected by a heavy pine girder 24 inches by 12 inches, resting on top of the plat forms and extending from end sill to end sill, acting as an immovable reach, while it also serves as a rigid backbone for the support of six oak triangles, each 6 feet on the base and about 6 feet on perpendicular.

These triangles are framed so that they straddle the girder or backbone, their sides extending to the line of the oil boxes on the car wheels, and their bases coming down to within 14 inches of the top of the rail.

Under the bases four truss rods are strung. The two outer ones are attached directly to the end sills, and lead down from them to the under side or base of the triangles, having the effect of putting down the ends of the car when the load is in position, and thus preventing sagging. The other two also run under the bases, but are attached to the inside end sills, so that their pull is contrary to the strain of the outer truss rods.

The triangles are capped at their upper apex with a heavy cast metal cap, and through these an iron shaft 2½ inches in diameter extends from end to end of car, the extremities of the shaft resting on braces built upon the end platforms.

This shaft serves as a bearing for straps of 6″×1¼″ iron bent thus, the lower end having a hook projection on which the edge of the stone rests.



The straps are in couples, with a 5″×6″ oak skid bolted between each pair, the skids being flush and parallel with the lower portion of the straps and extending above them as a support for the top portion of the stone when loaded.

The straps are bent at such an angle that when they are placed in position on the shaft (on which they simply hang by the circular slot cut in the angle at *B*) their lower edges rest against the triangles described above. The horizontal position of the straps are pierced at their outer end to permit an iron pin to pass through them and through upright iron rods which are fastened to the triangles on the opposite side to the load. These upright rods act as braces when the load is top heavy, and as tie rods when otherwise.

To load the car the straps are turned on their bearings until the hooked part and the skids which are bolted to them are in a horizontal position, and are blocked to prevent them falling. The stone is then rolled on to the skids until the edge comes against the hooks. The blocking is taken out, and the stone, which is now like the leaf of a table hung in the middle, is lowered until the skids rest against the triangles, a bar of railroad iron is passed through two eye-bolts, which are tightened by turnbuckles until the bar is pressed hard against the face of the stone, thus locking it into place, so that it cannot be jarred off the hooks, and the car is ready for the road.

The stone it was built to carry, while not the largest of its kind that ever came to New York, is yet by 4 feet 8 inches the widest that ever came by rail, and a stone can be carried 26 feet long and 15 feet 4 inches wide without interfering with tunnels and bridges.

There are several in New York nearly approaching these sizes, notably the three which are front of stoops of Messrs. Wm. H., Cornelius and Wm. H. Vanderbilt, Jr., respectively, and this special car makes it possible to send stone of that size almost anywhere that can be reached by railroad.



Receiver McNulta, of the Wabash road, has leased agricultural works at Springfield, Ill., which, it is stated, will be converted into a car building and repairing shop.

Widdifield & Bowman Brake Trial.

One afternoon in January, runs were made over a portion of the Lehigh Valley Railroad with a train of fifteen cars equipped with the Widdifield & Bowman Electric Automatic Brake, for the purpose of showing how it operated in controlling a train of cars. The brake is a development of the Widdifield & Button brake tried during the Burlington brake tests. It is still a friction brake, the power being supplied by a pulley brought in contact with a collar on the axle of the car, but electricity is employed to control the operation that applies and releases the brakes. One battery is placed on the engine and another in the way car, and the transmission of the electric force is so arranged that the brake is automatic and applies should the train break in two. The application of the brake can also be very evenly graduated.

A large party of railroad men, newspaper men and others attended the trials. Numerous stops were made and the brake operated very satisfactorily. There were service stops, emergency stops and breakaway stops, all of which were made without bumping or lurching. The main object of the trials appeared to be that of showing that the brake could be made to handle a train smoothly and automatically, and this it did to the satisfaction of all observers. As the brake was applied to one truck of each car, and as there were two heavy passenger cars behind without brakes, the record of the distance required to stop in could not be regarded as of much value. The parties interested in the brake say that they are going to apply it to fifty freight cars and exhibit in different parts of the country its capability to handle a train of this length.

Mr. D. H. Barrett, chief of the chemical laboratory of the Baltimore & Ohio Railroad, has been making a great many experiments lately to test the value of oils supplied to the company, and his work has materially increased the mileage per pint used. He uses a viscosimeter of his own design, which tests cylinder oils under conditions similar to those present in the cylinder. The facts learned by experimenting with this instrument have led to a great improvement in the character of the oil used and a material cheapening of the cost per 1,000 miles run, besides the introducing of a lubricant that is better adapted for the rubbing surfaces than those formerly employed. In tests made to determine the relative value of grease and ordinary black oil as a lubricant for journals, it was found that the bearings wear was 7 per cent. greater with grease than with oil, and that the temperature was 10 per cent. greater. A systematic examination of the waters used for supplying tanks on the whole property has lately been begun.

Mr. W. T. Ledford, foreman of the Richmond & Danville paint shops, at Manchester, Va., gets out his work as promptly as anything that can be found on this continent in the line of car painting. The company have very few passenger cars to spare, and the policy is to keep them in first-class order, and to have them looking fully as bright and business like as the cars on any neighboring roads. To accomplish this they must not linger in the paint shop during the regular visits there. Below is a schedule of daily operations on a coach when the body paint is in good condition: Monday, wash down inside and outside, varnish inside, apply coat of tuscan red and lead (half and half); Tuesday, sandpaper, apply coat of varnish inside, sandpaper outside, apply coat of tuscan red at 10 A. M., apply second coat at 2 P.M., apply thin coat of rubbing varnish at 5 P. M.; Wednesday, rub down inside and ornament outside; Thursday, trim and varnish outside, rub varnish; Friday, hair off and fine varnish; Saturday, hair off and fine varnish, leaving car ready to go out next morning. They have an excellent paint shop properly heated and the high temperature is maintained all night.

Richmond Locomotive Works.

A short distance away from the repair shops of the Chesapeake & Ohio, in the suburbs of Richmond, Va., we found the Richmond Locomotive and Engine Works, and were very much surprised at the extent of the establishment. For years the company owning these works have been engaged in the construction of stationary and portable engines, boilers, saw-mill machinery and a great variety of other machine work, and they have provided themselves with first-class shop tools and appliances for carrying on the business. The building of locomotives is a branch of the business not long followed, but they have built a great many small narrow gauge locomotives, that are very highly spoken of by the parties using them, and the Cole pole road locomotive, many of which are doing good work in various Southern forests, have all been built by this company. Still more recently they have taken up the business of building standard gauge locomotives of any size or style, and they are now prepared to compete with all other makers in furnishing railroad companies motive power of all descriptions.

The works are handsome structures of red brick, built in three parallel lines and across one end, the other end being open for the entrance of railroad tracks. Although the works have not yet been built for the manufacture of locomotives, very easily executed changes will put them on as good a footing for doing this kind of work as most shops that are in the business. They have a great variety of tools adapted for turning out all varieties of machine work, from a tap to a propeller shaft; they are all of modern make, and the shops are unusually well supplied with cranes and other labor-saving appliances. To compete fairly in heavy locomotive building some special tools that they do not have are necessary, and we believe they are about to put in important additions to their equipment, an extension of the machine shop being partly built. The boiler shop has a good hydraulic riveting plant and all the most approved tools for turning out good boilers, and the appearance of the finished boilers indicates that the men in charge understand how to use the appliances provided to the best advantage. The foundry appears to be exceptionally well run, and the heavy castings produced would be a credit to any establishment. Adjoining the foundry is the pattern store house, a three-story, fire-proof brick building, with a tower on one corner containing a water tank. The patterns are arranged and indexed so that there is no delay in finding what is wanted.

The tool room is well equipped with small tools, templates, gauges, etc., to facilitate the production of locomotives with interchangeable parts. They have in use the check system with messengers for carrying tools to and from the workmen.

They have just finished several handsome 18 × 24 ten-wheel engines for the Georgia Pacific, and have orders in for a variety of work for Southern roads. They are also repairing some locomotives for the Chesapeake & Ohio.

Small compound locomotives are to be used for hauling freight to the Paris Exposition of 1889. M. Decauville, the builder of portable railway plant and equipment, has issued a circular stating that there will be about 12½ miles of track of 22.68 inches gauge, laid with rails weighing about 14 and 20 pounds per yard. The cars will be hauled by compound engines, weighing 9½ tons empty and 12 tons in working order. Over these lines will be transported the 40-ton guns which are to be exhibited by the Minister of Marine. The track will be of the Decauville system, the steel rails being riveted to steel cross-ties. A part at least of the line will be laid with the "portable" track.

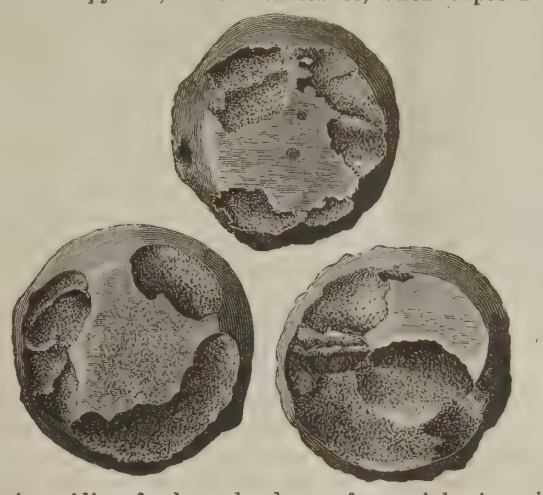
The following is a specimen of the contemptible rot which some of the New York daily papers inflict upon their readers in the shape of railroad notes. A reporter of the *Mail and Express* interviews the engineer of a locomotive pulling a passenger train and is told that the engine is suffering from a sulky fit. The engineer is reported to say:

"I have one of the best firemen on the road, the coal is first-class, her trains are never heavy, yet she won't work worth a cent. When I start out the steam is in good shape, her fires are drawing and everything seems just right, but by the time I get across the Harlem she begins to sulk. Her steam comes slowly, the fires don't draw and she seems all out of gear. There is but one thing to do, and that is to lay her up for a week. She don't need any tinkering; all she wants is to be let alone. Inside of a week I can run her out and she'll work as well as ever. Oh, no; it's not peculiar or uncommon at all. Ask any locomotive engineer in the country and he'll tell you the same thing. Why, out on the Western roads an engineer won't start out with a sulky engine. They have been known to die on the road between stations. An engine is said to die, you know; when her fires keep getting lower and lower, her steam gets soggy and weak, and the first thing you know she's stone cold with her fires out. Then you have to get another engine to pull her in, for she wont't be worth a cent until she has rested awhile," and he climbed into his cab and rolled out of the depot with his train and sulky engine.

The New York, New Haven & Hartford must have some very fertile minded jokers among the engineers and the gullibility of some of the reporters on the *Mail and Express* must be beyond human conception. The blue pencil of the city editor appears to have been suffering from cramps or paralysis, when it did not put the touch of oblivion upon such ridiculous trash.

Corrosion of Boiler Sheets.

The annexed engraving illustrates an extraordinary case of rapid corrosion that happened to a boiler in the shops of the Delaware, Lackawanna & Western, at Kingston, Pa. Kingston is surrounded with anthracite coal mines, and there are vast heaps of refuse coal culm lying all around the railroad shops. This culm contains a great deal of iron pyrites, and this substance, when exposed to



the air, oxidizes freely and releases free sulphuric acid. The heavy rains of this season had washed these culm heaps and carried free sulphuric acid into the source of the feed water used at the railroad shops. The flood of acid charged water arose suddenly, for there had been sufficient lime salts in the water to neutralize the acid for years, for the boilers had to have the lime scaled off about every three months. A new boiler was put in last year, and after it had been in use about three months a man went inside expecting to find scale to break off from the sheets, but instead of that the sheets were bare and all parts exposed to the water were deeply honey-combed. The boiler was so badly corroded that it was deemed unsafe to use, and the works were stopped till a substitute could be put in. The rivet heads shown were taken from the boiler. The holes eaten into them were about $\frac{8}{16}$ inch deep. All the surfaces of the sheets had holes of about the same depth.

Effect of Broken Steam Pipes in Cars.

We have seen many remarks made in the daily papers during the last three months to the effect that it was as well to be burned to death in a railroad car heated by stoves as it was to be scalded to death by escaping steam. This sort of talk was started by Mr. Furber, of the Boston & Maine, who displayed extreme reluctance to abandon the use of the car stove, and in his emphatic way declared to the Railroad Commissioners that the steam which would escape from pipes fractured by a collision, would be as dangerous to the passengers as the fire often started by the stove after an accident. Many smaller lights were ready to echo Mr. Furber's words, and the alleged danger from scalding steam has been used by more than one railroad manager as an excuse for defying the public sentiment that demands safer means of heating than the stove provides.

The assertion frequently repeated that a fractured heating coil inside of a car would be as disastrous to the passengers as a boiler explosion, produced a certain degree of nervousness among travelers, for most people are ready to take for truth any statement made about matters they do not understand. This dread of steam was, no doubt, the cause of a panic that happened lately in a car where a steam heating pipe broke when the train was running. As the steam began to escape and fill the car, a rush was made for the door, and several persons were hurt and bruised in the struggle which ensued, but no one was the least injured by the escaping steam, although the obvious precaution of opening the windows was not taken.

We have several times insisted that the conditions which make a boiler explosion fatal to the persons near are not present when the vessels which hold steam for heating purposes get fractured. When the sheets of a boiler yield suddenly, the reduction of pressure that instantly ensues permits the latent heat in the water to flash into steam, and an immense cloud of hot vapor, sixteen hundred times the volume of the water, and at boiling heat, is spread around. The volume is so large and dense that it has to spread far before it mixes with sufficient air to cool the steam below the burning point. When a steam pipe bursts, on the other hand, all the steam which can escape is that within the pipe, or the quantity that the unbroken portion of the pipe will pass through. The volume that can pass through an opening of one inch diameter into a large space like the inside of a car must be a long time in filling the body to a temperature that would burn any person, even when the means of ventilation are kept perfectly tight. When the car is properly ventilated, the steam cannot be made to heat the place to a dangerous temperature. Every one familiar with vapor baths knows how long it takes to heat up a close room with steam, and this experience ought to be an object lesson against panic from the bursting of steam heating pipes in railroad cars.

Since the above was written we have received particulars of a most seasonable test made in a car belonging to the Old Colony Railroad at Boston to ascertain the effect of a fractured steam pipe. A globe valve was provided inside the car with an opening 1½ inches diameter, the full size of the train pipe. The test was watched by the Railroad Commissioners of Massachusetts, Professors Swain and Lanza, and others, and was managed by Mr. J. N. Lauder, superintendent of rolling stock of the Old Colony. The pressure of steam used varied from 20 to 80 lbs. to the square inch. When the steam was escaping at the highest pressure, no danger or inconvenience was experienced from sitting within a few inches of the screaming valve. The steam filled the car, but it did not exclude the air sufficiently to make breathing difficult, and the heat generated was not intense enough to do any damage. The varnish of the car was not whitened, even at the points nearest to the exit of the steam.

The Metric System of Measurement.

At the January meeting of the New England Railroad Club, the principal business was a discussion on the above subject.

Mr. George Richards explained the metric system of weights and measures used in France and many other countries. Believed that a uniform system of measurements would be the best for the railroad service, and expressed the opinion that many of the objections raised to the metric system would vanish on trial. He concluded:

Let us cast aside the old system, or lack of system, with its useless and misleading terms, its inches, feet, furlongs, ounces, drachms, cords, pounds and tons, and substitute for it this simple and efficient method, the substance of which can be written upon a card no larger than the hand; and with it we can

> "Measure earth, weigh air, and state the tides,
> Instruct the planets in what orbs to run,
> Correct Old Time and regulate the sun."

Mr. C. W. Swan gave a brief history of the metric system. Its simplicity, said he, constitutes the great merit of the system. The objections resolve themselves into this: that persons who are accustomed to a certain method don't like to change, even though another one proposed may be better. There can be no objection to the system itself.

Mr. Frederick Brooks warmly advocated the adoption of the metric system. The objection to it, he said, sometimes takes the form of a suggestion that some of the old measures had better be adopted and used as the basis of a new system instead of the meter; and in that form of argument we detect the real objection; the objector does not want a change. The proposition to decimalize the foot comes from the civil engineer, who already uses it in that form; and the proposition to decimalize the inch comes from the mechanical engineer, who would be suited by it.

Mr. J. W. Marden, Fitchburg Railroad, saw no difficulty in the adoption of the metric system, and favored recommendation for its use to all railroad companies' shops. Wanted the club to recommend the Executive Committee of the Western Car Builders' Association to appoint a special committee to bring the subject up for consideration.

Several more schoolmen and others anxious to see the metric system forced upon the country gave their views, and a resolution was adopted to the effect: That the New England Railroad Club recommend that the Executive Committee of the Master Car Builders' Association appoint a committee on the metric system of weights and measures, to report at the next annual meeting of the Association."

Driver Brakes.

Mr. George H. Poor, of the American Brake Company, has published in *Trade and Traffic* a vigorous answer to the statements made in the paper on "driver brakes" read at the November meeting of the New York Railroad Club and summarized in our December issue. We quote from Mr. Poor as follows:

In an article read before the New York Railway Club Nov. 15 last, on "driver brakes," there are a great many things which show the author's ignorance, or unfamiliarity, with actual practice, and which demand our criticism. He says that "a device to whose keeping human lives are intrusted can not be pardoned for failure to do its whole duty, and no practical device can reach this high standard that uses a brake block on one side of a wheel only." If pains had been taken to investigate this matter a little more carefully he would have ascertained that there are a large number of engine brakes with a block on one side of the wheel only, now in actual service, that reach this high standard, as will be illustrated further on.

"Simplicity and certainty are the two indispensable essentials in all practical railway work," is the language used. Now, if the device, with its 161 parts and 103 joints, which is illustrated by the author of the article referred to as being a perfect device, as applied to an eight-wheel connected engine, is what he calls "simplicity," then we are entirely in ignorance as to the meaning of that word. Regarding its "certainty," we will only quote an extract from the report of a prominent professor of mechanics on this device: "As a problem in statics, the number of wheels may be infinite. As a problem in kinematics, or in motion of parts, the limit is soon reached."

In order to obtain simplicity some sacrifice of theory has to be made in nearly all mechanical devices, and when this can be done without impairing the efficiency of the device, there is nothing lost; and this is one of the reasons why the one-shoe brake, with its 47 parts and 28 joints, was devised.

Regarding the idea of placing brake blocks upon the forward truck wheels, we suggest that while, of course, it is very desirable to apply braking pressure to every wheel on both engine and train, the idea of practicability must be taken into consideration, and as the proportion of weight on the forward truck of the engine to the entire train is so very small, the difference in distance where a stop is made with the forward trucks not equipped with a brake would be hardly perceptible, and the difficulties and dangers attendant upon applying a brake to the wheels of the forward truck are too manifest to admit of adoption.

The article also states that 80 per cent. of the wheel weights has been adopted as their standard pressure. A large number of engines that have been equipped with 60 per cent. of the wheel weight for braking pressure, after being put in service, have had the percentage of braking pressure reduced even below that, as master mechanics and engineers complained that the power was too great, and after the change they gave perfect satisfaction. Under the most favorable circumstances, and while an engine is running at speed, there is no doubt 80 per cent. of the wheel weight can be used; but on switch engines, where the speed is generally very low, and in making stops with road engines, after the speed is under control, 80 per cent. of the weight for braking pressure has been found by actual practice to slide the wheels, causing a great deal of trouble and damage.

Communications.

Locomotive Fire-Boxes.

Editor National Car and Locomotive Builder:

In his communication in your last issue, Mr. G. W. Cushing correctly states that an inquiry as to the merits of the combustion chamber cannot be properly answered without a reference to the brick arch. The advantage of the former has been and remains an open question, but that of the latter is now so fully and generally recognized as to render it a standard element of advanced and intelligent practice, and the advocates and opponents of the combustion chamber can, without abandonment of the position held by either, consistently meet on common ground in the indorsement of the brick arch.

Among other useful functions of the brick arch, an important, if not the most important, one is that it serves to form a space within the fire-box which performs a duty corresponding in kind to, although differing in degree from, that of the combustion chamber properly so called; that is to say, one which is located in the waist of the boiler and does this without sacrifice of tube heating surface, and with less structural expense as compared with the waist combustion chamber. The modification of the Wootten boiler, to which Mr. Cushing refers, in which a combustion chamber is formed in the fire-box by a brick wall extending upwardly from the grate, is designed to approximately attain the advantage of the combustion chamber, without involving the objections which have been urged against it, as well as to admit of the location of the grate nearly on a level with the lowest row of tubes, as in the standard Wootten boiler, without allowing coal to enter the tubes. This construction, which is illustrated in Mr. J. E. Wootten's Patent No 352,215, dated Nov. 9, 1886, is analogous to that subsequently proposed by Mr. C. M. Higginson, in Fig. 3 of his paper read before the Western Railway Club, Nov. 20, 1888. Mr. Cushing's belief that it was patented by me is probably due to the fact that my signature appears on the drawing, but this is only in my capacity of attorney. Another modification in which a similar brick wall is used in combination with a central longitudinal water leg, forming two independent furnaces, was patented by Mr. Wootten and myself jointly April 19, 1887 (No. 361,661), but this patent expressly disclaims the construction of No. 352,215. That I may not be credited with an improvement to which I am not entitled, I desire to here confirm that disclaimer in view of the reference to the subject matter in Mr. Cushing's communication.

PITTSBURGH, Jan. 7, 1889. J. SNOWDEN BELL.

Training Workmen.

Editor National Car and Locomotive Builder:

In your January number there is a paper by Mr. F. S. Ball, which contains statements which I should like to discuss in my favorite paper. The question raised apply to all departments where skilled labor is employed, and I consider it is right and proper that as representatives of railroad companies, our position and duties in regard to the training of workmen should be distinctly understood. Mr. Ball starts by telling that apprenticeship is a thing of the past, then he proceeds to examine the causes that have led to this. The principal argument reads:

What has brought about this state of affairs in the industrial world and on whom rests the blame? Clearly, one answer is organized labor itself. Blinded by selfishness and ignorant of its best interests, it long since issued its fiat that only a limited number of boys shall be received as apprentices in any one shop; that only a limited number of American boys shall be permitted to learn a mechanical trade.

He then mentions that contract work in shops is an obstacle to the training of apprentices, as men engaged on piece work have no time to devote to the training of learners. The proposal to train young men to industrial pursuits requiring developed skill by industrial schools is examined and the plan rejected. The conclusion is reached that "proficiency can only be obtained in the workshop and under the apprenticeship system, which should be re-established on a sound and practical basis." The proposal is then made that railroad companies proceed to infuse life into the moribund apprenticeship system and bear extra expense training apprentices, so that there may be a good supply of American-born workmen for the trade.

Now let us first examine the causes of the decadence of the apprenticeship system. Mr. Ball puts the principal blame of lack of apprenticeships to the labor unions, but I am disposed to doubt the correctness of his opinion. The assertion that labor unions oppose the old apprenticeship system has been repeated so often that nearly every man believes it to be true, yet I have never known a single case where a labor union tried to curtail the number of apprentices in a railroad shop. The thing may be done, but it is not common, and certainly is not the principal cause for so few American boys becoming apprentices. The fact is that the best American shop practice is unfavorable to the training of apprentices. Work in the best run shops is done on a manufacturing basis, subdivision of labor being made the best of. The contract systems where work is paid for according to the quantity turned out is constantly extending, and is destined to become universal. These are the peculiarities of our workshops that enable us to compete with the lower paid mechanics of foreign countries, and it is not likely to be changed because it interferes with the training of mechanics. I think that really there is very little cause for worry about the scarcity of apprentices. If we possess our souls in patience, the malady will bring about a cure for itself. The true cure is certainly not in the recommendation of Mr. Ball, that railroad shops be turned into training schools for apprentices. Railroad companies are already called upon to do too much eleemosynary work without going into the dry nurse business. The duty of men in charge of railroad shops is to adopt the methods by which work will be produced at least expense to the company, and to hire the mechanics best qualified to perform the work properly. This is business. If it is not conducive to the future prosperity of a State, it is the duty of our legislators to devise a remedy.

SUPT. M. P.

Car Building in Repair Shops.

Editor National Car and Locomotive Builder:

There has been at times a great deal said about the advisability of building freight cars at home, it seeming to be the general belief, and probably a correct one, that the work thus done is more honest; but it is also generally admitted that its price is somewhat higher than that done in contract shops, and this after making due allowance for the difference in quality.

Our Master Car Builders usually plead want of improved machinery and proper facilities when asked to explain this difference in cost, an instance of which can be found in the discussion on railroad shops in the December meeting of the New England Club.

Now I think that the labor required in the construction of a freight car is at present as economically performed in railroad shops as it is in contract shops, and that the difference in cost, to which must be added the profit of the manufacturer, is abundantly accounted for by the better discounts the latter obtains when purchasing the different raw and partially manufactured materials—this because he is a larger purchaser and makes a specialty of a comparativly few number of articles, while the purchasing agent of a railroad can give this part of his business but a divided attention.

The labor item of a freight car does perhaps not exceed 10 per cent. of the total cost, and a reduction in this by means of superior machinery and facilities, as claimed, could amount to but a few dollars at best. But it is questionable whether the contract shops can do even this any more than the railroad shops, which nearly all have sufficient machinery to successfully compete in freight car building, and the larger roads have all that can be used for this purpose and enough for building passenger cars.

If there is any difference, it should certainly be in favor of the railway shop, if of the same capacity, as its operations are confined to cars peculiar to that particular road only, and every employé about the establishment is familiar with every detail pertaining to their construction. The contract shop has to build cars of every conceivable pattern, and with every new order is obliged to make a new set of patterns and formers (or at least make a radical change in them), which are of but little value when the order is filled.

It has often been stated that the primary object of railway companies being the transportation of freight, they should not engage in the manufacture of cars. This would perhaps be the correct view if they were building for others; but this is not the case; they usually do enough new work only to replace that worn out and destroyed in service, and leave the building of additional rolling stock required by an increased traffic or an extension of the road to the contract shop.

It is both convenient and economical to do some of this new work; it justifies improved facilities and the constant employment of a moderately large working force for making the repairs on disabled cars both cheap and prompt. the new work being resorted to in the intervals when repair work is slack. It also affords an opportunity to work up much of the iron work from condemned cars which would otherwise serve to swell the scrap pile.

It does, however, not pay to build the cars demanded by an increase or extension of business, as there is not enough of this to warrant the expense of a necessary large plant to fill these somewhat periodical orders promptly.

V. W.

Malleable Iron and Steel.

Editor National Car and Locomotive Builder:

I have read with interest all the letters that have appeared discussing the relative merits of cast-iron, malleable iron and cast steel for car building, and I think the subject is well worthy of more attention than it has received from railroad men. The various parts of cars are subjected to such hard stress in carrying the heavy loads that are now common over rough track, that we are all constrained to increase sizes to give sufficient margin of strength. We have not gone far in this departure when we are met by the protest from general officers that we are increasing the dead weight too rapidly. The remedy for this is stronger material, so that the required strength will be found with a smaller amount of material. The best suggestion is, substitute malleable iron for cast iron; but sensible, intelligent reflection comes and asks, Why halt at a material of medium strength when a stronger material is beyond at very little greater price? Why adopt malleable iron when we will soon be forced to abandon it for cast steel? The correspondent who signs himself "Malleable" has a very warm regard for malleable iron and has exhausted the arguments in its favor, but I for one am still doubtful about the expediency of going half way when a reform is necessary. He speaks about the reliability of malleable iron of "established quality." But the important question is, how are we going to find out what is an established quality? I have found the malleable iron that came within my range of experience little if any better than good cast-iron, and it is a product there is no certainty about. An honest maker may no doubt turn out malleable iron of high tensile strength, but the material gives too many opportunities for deception. The finger of modern progress points to steel as the coming material for strength and lightness combined, and I for one will do all in my power to follow in the right line. All other car-builders who read the signs of the times will do likewise.

ANOTHER CAR-BUILDER.

Locomotive Draft Appliances.

PITTSBURGH, Jan. 19, 1889.

Editor National Car and Locomotive Builder:

My attention was attracted by an article in your issue for January from the pen of Mr. G. W. Cushing, wherein he makes many interesting statements in regard to best form of fire-box, advantage of using brick arches, method of placing them in fire-box, and the saving of fuel, decreased throwing of fire and prevention of smoke resulting from their use.

Now, so far as my humble experience has led, I most heartily endorse all Mr. Cushing said on these interesting topics. I can see, after carefully reading the article, that he is exceedingly well acquainted with the subject under discussion, and his conclusions agree with my observations during the past fifteen years. But I would like to ask one question on the relation of arches to flue wear. I noticed a locomotive recently with plain fire-box, with brick arch supported on angle irons, resting on studs in side sheets. The flues leaked very often, so arch had to be taken down once or twice each week to have flues calked. Finally, the arch was left out entirely, and flues have not leaked once since in about four months.

Mr. Cushing states that he believes flues wear longer without repairs when an arch is used, yet my experience points to the contrary in the instance just cited.

It is proper to state, however, that I have not noticed this trouble with flues where arches are supported on arch pipes fastened into back and flue sheets. My conclusion is that there must be a great deal depending on the method of placing the arch so far as regards wear of flues, consumption of fuel and prevention of smoke, far more than the practice on several roads would seem to indicate.

There is much diversity of opinion among heads of mechanical departments regarding the merits of different devices and proportions of locomotives. Your article on "Diversity of Railroad Machinery" is to the point. Some men favor high driving wheels, yet their engines do not make good time. They are too slow in getting a train going, too slow on the stiff grades, slip more than those with lower wheels, break many axles in service and manage to arrive at terminals late entirely too often. When driving-wheels of passenger locomotives are more than 66 inches in diameter over the tires, you are getting an engine more ornamental than useful. They make good locomotives to travel down grade, but, unfortunately for them, roads are built with an up grade now and then. In my opinion 62, 64 and 66 inches are good sizes for passenger locomotives. The least of these sizes will make good engines where much stoppage is necessary; the highest will make 60 miles per hour without attaining too high a piston speed, and as most passenger runs do not exceed a maximum of 40 or 45 miles per hour, this size of wheel ought to meet all the requirements, even under a 55-ton engine, if engine has well-designed driving boxes.

Some men favor high nozzles, others prefer low ones; some men believe in using single nozzles, others use double ones.

My preferences would be toward double nozzles if the exhaust could be forced out in the direction of center line of stack, but this is difficult of accomplishment with this form of nozzle. So we have to use a single nozzle, and consequently have to make nozzles higher than when double ones are used.

I am of the opinion that low nozzles decrease the back pressure, and permit engine to do better work than high ones, for my recollections of the past, when we used a nozzle 4 or 5 inches high, with lift pipe and diamond stack, leaves the impression vividly on my mind that engines at that period did better work than those at present with much higher nozzles, that seem to be a necessity inseparable with using extensio fronnts.

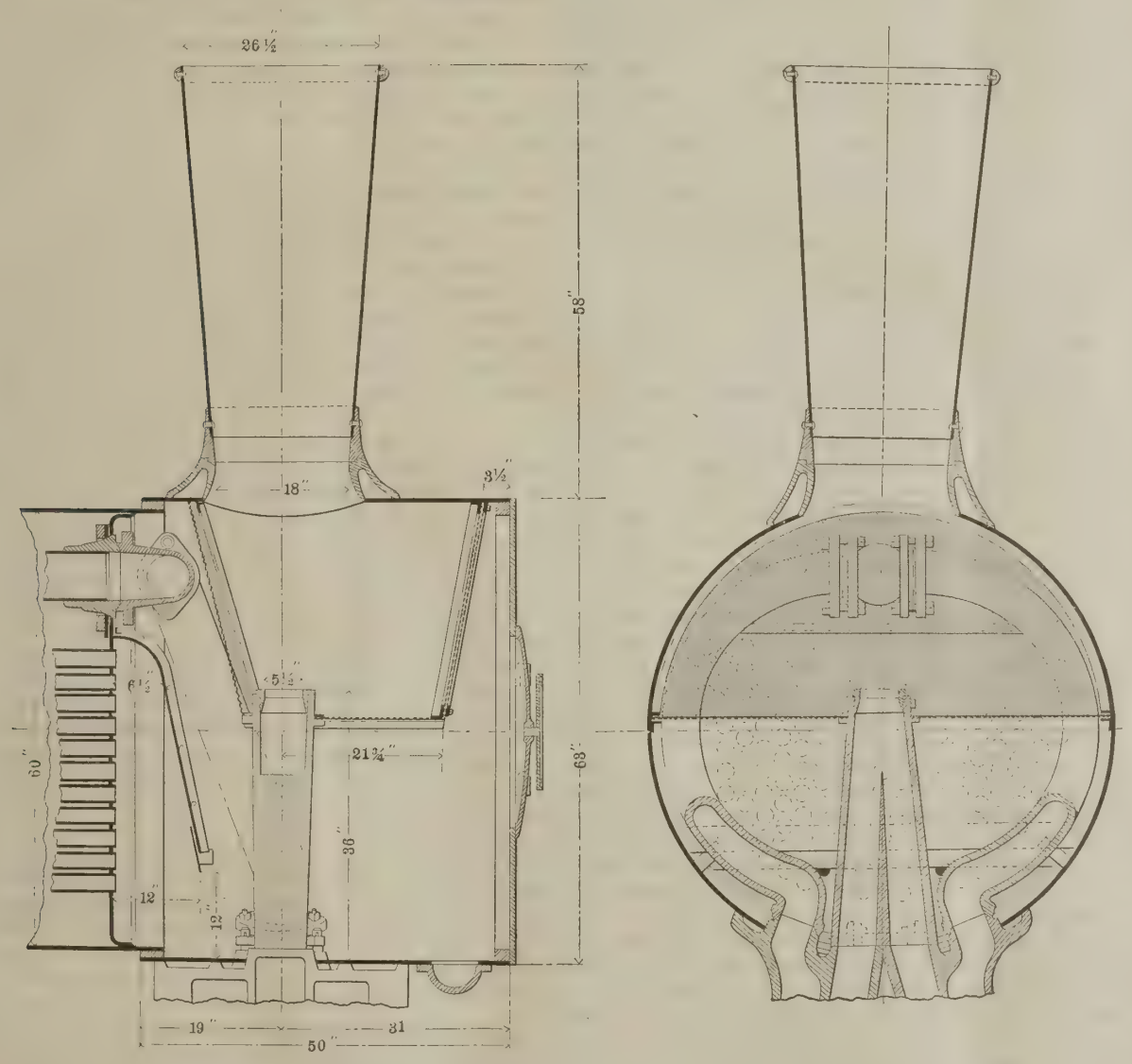
That the great diversity of locomotive designs, often in even trifling matters, is a source of vast expense to the companies who are unfortunate in their selections of different builds, is a self-evident fact. It would seem that there should be no difficulty in arriving at a definite idea as to the merits and demerits of any device used on locomotives, but such does not seem to be the case. So far, I believe, however, that when railroad companies are disposed to do a little more careful testing under the directions of educated and trained mechanical experts, they will quickly relegate many present devices to the scrap heap, and that there will be less isolated individual experiments at the company's expense by mechanical heads of departments, who are neither thoroughly grounded on the theory of mechanics nor oftentimes know even the primary laws of combustion. It is very true that there are many men holding very important positions in the mechanical world who have a vast amount of experience that if it could be used to aid a well educated, theoretical mechanic in making exhaustive tests many important facts might be illuminated that would far advance the science of locomotive design and greatly diminish the present expensive diversity of construction.

J. J. CLAIR.

Bell Extension Smoke-Box.

Editor National Car and Locomotive Builder:

The construction illustrated in the accompanying blue print is submitted as embodying all the advantageous elements which can be found in the present extended smoke-box practice without the objections of an inordinate and unmechanical increase of smoke-box volume and



weight on truck, and as evidencing the practicability, which is generally denied by the advocates of the extended front, of obtaining ample and sufficient area of netting in a smoke-box which accords substantially with D. K. Clark's rule as to normal and determined relation to grate area. No originality is claimed for the design, either as a whole or in detail, and each of its separate elements will be readily recognized as having been for some time in successful operation. By comparison of the netting with that of the Old Colony Railroad pattern as shown in Pl. 52 of the Master Mechanics' Association Report for 1885, which arrangement is alleged to be an entirely satisfactory one, it will be seen that a greater area is presented in this case, and the upwardly inclined sheet in rear of the exhaust nozzle obviates the necessity of joints around the steam pipe. The smoke-box projects sufficiently over the saddle to admit of the attachment of the usual blow-out device (which ought not to be necessary with a properly proportioned fire-box and a brick arch) or of a pipe to a separate spark receptacle, as in the Mitchell and the Wilson constructions, either of which may be employed with advantage in connection with the draft and spark arresting appliances shown.

J. SNOWDEN BELL.

Fire-Boxes.

We have received from Mr. C. M. Higginson several letters elicited by our comments on his paper on "Burning Soft Coal in Locomotive Furnaces" read at the November meeting of the Western Railway Club. Mr. Higginson and other railroad men we have conversed with on this subject appear to be under a misapprehension respecting our article, which the paper by Mr. Higginson brought out. They appear to have concluded that we were all the time discussing the paper, while in fact we were treating the subject from an independent standpoint. Our advice against trying to perfect combustion by admitting air into the combustion chamber was suggested by several expensive failures we had seen made with furnaces so arranged, and most of our remarks about combustion chambers were based on personal experience. As the subject treated is thoroughly worthy of being discussed, we have pleasure in putting before our readers the continued views of Mr. Higginson. He says:

The only reason I presented the original paper was to start a discussion, so the wider it becomes the better. Of course, from a standpoint of merely personal interest, as long as the Chicago, Burlington & Quincy made progress in this direction, what was done elsewhere would not interest me particularly. I note your renewed warning against combustion chambers, but my paper distinctly stated that I did not approve of them without the brick arch and hollow stays for our coals, and I certainly did not intimate that I would admit any air directly into the chamber, as the closing sentence in your editorial would seem to infer. I still find no record here or abroad that the style of construction shown in your cut No. 2, being for eight-wheeled engines, has ever been carefully tried.

The Mogul box, shown in your cut No. 1, works so well on our engines that it needs no further defense. The combustion chamber in this style is quite large already, and as stated in my paper, I would only advise a very short extension (if any) into the boiler shell. I think they will have to use a little more air than they are doing now to get the very best results. The Chicago, Milwaukee & St Paul and Wisconsin Central roads report good results from increased air admission. They use quite large tubes (2 inches, I think).

I should like no better work than to take some engines with about a 20-inch combustion chamber, a brick arch, and hollow stays averaging say $\frac{1}{75}$ of the grate surface, and run them against similar engines on the New York Central with the water-table fire-box. You notice that I do not advocate as long a combustion chamber or as many hollow stays for that region as I do for the West, and for anthracite burning I would not use a combustion chamber, as far as complete combustion goes, and would reduce the hollow stay proportion to about $\frac{1}{100}$ of the grate surface.

In the change which is going on in fire box construction, have you paid much attention to the relative heating value of the different parts of the flues? The reduction of the blast causes a slower travel of the products of combustion through the tubes, and will probably reduce the comparative value of the last few feet as compared with the portion nearest the fire-box. It has been abundantly proved that the higher the blast the higher the relative value of the last portion of the flues is, though this fact is independent of any question of economy of fuel. I think that the reduction in draft by the open stack has changed the conditions to some extent as regards evaporative power of different sections of the flues.

Chesapeake & Ohio Rolling Stock Notes.

During a recent visit to Richmond we found our friend, Superintendent of Motive Power Garstang, of the Chesapeake & Ohio, busy on numerous schemes for the betterment of the rolling stock under his charge. The company have a great many cars under construction in a variety of contract shops, and Mr. Garstang is kept busy visiting the different works and attending to the ordinary routine business of his department. He has lately designed a type of box car which is so constructed that it can conveniently load coal out of the pit chutes and yet is sufficiently weather tight to carry grain. General Manager Odell speaks very highly of the advantage the company is reaping from the use of this car.

Among the new equipment that the company have under contract are four complete trains of vestibule cars, which will be run between Richmond and Cincinnati. They have several hundreds of the New York Iron Car Company's cars in use carrying coal, and they are giving so much satisfaction that additions are about to be made to this kind of rolling stock.

During a brief visit to the repair shops at Richmond, we found Mr. W. J. Haller, master mechanic, exceedingly busy with rolling stock repairs. Like too many other railroad shops, those belonging to the Chesapeake & Ohio at Richmond are very far behind the requirements of the work that has to be done. In fact, the shops are an assortment of sheds that have grown up part after part, and as usual in such places the work is performed under great disadvantages. They are systematically reducing the locomotives to few standards, and all repairs of motive power are influenced by this aim. There are five standard locomotives, but as many parts as possible of engines of different standards are made interchangeable. Within a year they have put new cylinders into nine engines at these shops, which are merely division shops, and the other repairs have been in proportion. The boiler repairs are light on account of the pure water used on most of the divisions. They have sets of flues that have been running five years without being taken out of the boiler, yet the engines are worked very hard and make long average mileage. The standard freight engine is of the consolidation type, with cylinders 20 by 24 inches, wheels 51 inches outside of tires, boiler 58 inches diameter, containing 244 two-inch flues, 12 feet 8 inches long. The total weight is 122,400 pounds, 109,300 pounds resting on the drivers. The standard passenger engine has cylinders 19 by 24 inches, and a total weight of 102,000 pounds. They are well-proportioned locomotives and do excellent work.

In the car department there is little doing except repairs, but there is no lack of work in that line. The company does a heavy coal business, and 60,000 pounds is a common carload; all the cars that the heavy consolidation engine described can haul are put on as a load, and that kind of service is extremely trying to cars, so repairs are naturally heavy. About 50 per cent. of the locomotives running out of Richmond are consolidations, and the average mileage is 4,200 per month, so it is not surprising that car and locomotive repairers are kept busy.

The National Paint Works at Williamsport, Pa., appreciating the value of the services of their employés, presented each of them at Christmas with a good serviceable overcoat. It is probably by means of such generosity and thoughtfulness for the comfort of their employés that this well-known firm keep up the reputation they have gained for the uniformity in quality of the paints they manufacture.

In the articles on railroad subjects that have appeared in *Scribner's Magazine* during the past year, the locomotive engineer has received a great share of attention, and in nearly every instance he has been spoken of as the locomotive runner. This is, no doubt, all right and proper, and it is generally regarded as degrading for men calling themselves mechanical engineers to speak of the man who operates the locomotive as an engineer, so it is in accord with this spirit for magazine writers to confine themselves strictly to the term runner. But when one of them says, as he does, that railroad men generally call the man who occupies the right-hand side of the locomotive a runner he says what is not true. Tho popular voice and the railroad world with one accord call the man who operates the locomotive a locomotive engineer, and the writer who pretends that runner is the popular word tries to distort the truth or displays ignorance of what he is writing about.

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EDITORIAL ANNOUNCEMENTS.

Advertisements.—*Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING COLUMNS. *The editorial department will contain our own views and opinions; and the rest of the reading matter, aside from advertisements, will be such as we consider of interest to our readers.*

Contributions.—*Articles relating to railway rolling stock construction and management, and kindred topics, by those who are practically acquainted with these subjects, are especially desired. Also early notices of changes in railroad officers, organizations and names of companies.*

Special Notice.—*As the* CAR AND LOCOMOTIVE BUILDER *is printed and ready for mailing on the last day of the month, advertisements, correspondence, etc., intended for insertion, must be received not later than the 25th day of each month.*

Metric Measurements in Railroad Shops.

At the January meeting of the New England Railroad Club, the subject of "The Metric System of Weights and Measures" was discussed, and every speaker was in favor of the general introduction of the system, some of them seeing no difficulty about its immediate adoption as the basis of measurement in railroad car shops. The feeling ran so strongly in this line of progress, that a resolution was adopted requesting the Executive Committee of the Master Car Builders' Association to use their influence to have the Association consider the advisability of adopting the metric system. We were not at all surprised to read what the college professors and school engineers who spoke at the meeting had to say in favor of the metric system, for their ignorance of practical mechanical work blinds them to the difficulties in the way of the adoption of a new system of metrology by a great manufacturing nation; but it was something surprising to see a change of this momentous character advocated by men who are responsible for the production of mechanical work in railroad shops. We do not believe that the men who are anxious to see the Master Car Builders' Association adopt the metric system of measurements, realize the stupendous nature of the change they are committing themselves to support. We shall endeavor to give railroad mechanics a few particulars of the system they are about to see urged as a substitute for measurements based on the inch.

For many years before the end of the last century great confusion existed in the weights and measures used in different parts of France, and about the period of the revolution the urgency for a uniform system became so great that it was pressed upon the attention of the government. That was a time when the reform and regeneration of mankind were deeply attracting the attention of philosophers. That class was highly powerful in France in those days, and its members were ready to exude from their inner consciousness anything from a new religion or government to a new vice, and the furnishing by them of a new metrological system was a mere bagatelle. They took as the unit of their system, what they incorrectly calculated to be the forty-millionth of the earth's meridian, which passes through Paris. This they called the meter. Its length is a trifle over 39.37 inches. Its divisions and multiples vary in a ten fold ratio. The first division by 10 makes a "decimeter," 3 937 inches. The second division makes a "centimeter," 0.3937 inches. The third division make a "millimeter," 0.03937 inches. The multiples make in succession dekameter, hektometer, kilometer, and myriameter, all increasing 39.37 inches by ten times. The cubic measures and the weights also have units based on the meter. After a long struggle this system was forced upon the French people. In the different states that compose Germany, there was great diversity in the character of the weights and measures used, and the metric system was adopted to bring about uniformity, but the change caused very great inconvenience for years, and the meter basis is still found to be much inferior to the inch for machine shop practice. The other countries that adopted the metric system had little commerce and less manufactures to be thrown into confusion by a change of metrology. England with its varied manufactures never seriously thought of changing from the inch unit.

If the proposal to introduce the metric system into this country had been pushed at the beginning of the century, the change might have been effected with little inconvenience or expense; but there are so many things established now on the basis of inch, foot and yard measurements that a change would lead to intolerable confusion. All the land in this great country is divided up into parts measured by the foot or its multiple. To apply the metric system to the description of our town lots alone would lead to a useless increase of figures that the people would not endure. But it is when we enter the machine shop and the factory that we can thoroughly realize the stupendous nature of the change proposed. For a century our mechanics have been laboring on the establishing of interchangeable parts in all lines of machine work, and the parts have all been designed on the basis of inch measurement. There are in our workshops millions of tools made to standard sizes based on the inch. Our standard system of screw threads is based on the inch, and the vast plant of machinery designed to produce our great variety of screws would be lost if a change of standard were introduced. Many defenders of the metric system say that they do not advocate changing established standards. Let us see how we could apply the new names to the old sizes. The successful operating of a machine shop depends in a great measure on sizes being readily understood. When a mechanic examines a drawing, it is of the greatest importance that the size he is to put into wood or metal should come to his mind readily without study or calculation with marking materials. The fewer figures that he has to mentally grasp in a measurement, the less chance will there be for a mistake. A common job in a machine shop is to make a bolt $1\frac{7}{16} \times 6\frac{1}{4}$ inches, with taper $\frac{1}{16}$ in 12 inches. A machinist reads this in the drawing, and his familiarity with the two-foot rule enables him to go on with the work without an instant of delay in making calculations.

The meter scale cannot be used in machine shop work because nearly all measurements are less than a meter, and the use of that scale would lead to no end of decimals. Therefore the millimeter scale is used in all French and German shops. By this scale the bolt mentioned would be described 36 5125 × 158.75 mm., taper 1.5875 in 304 8 mm. If the machinist was as familiar with the millimeter scale as most of our men are with the inch scale, it is obvious that the increased number of figures employed would increase the liability to make a mistake in the measurement. Where a system of measurement requires many figures, it prevents people from memorizing dimensions, and consequently it calls for more time to do work. The Master Car Builders' and the Master Mechanics' associations have adopted certain standards whose dimensions have been memorized by the persons having to design or make them. The few figures required in expressing the dimensions in feet and inches are easily remembered. Put the dimensions into the metric or millimeter scale and memorizing becomes much more difficult. Take the M. C. B. standard axle for instance. The total length is 6 feet $11\frac{1}{2}$ inches, or $83\frac{1}{2}$ inches. In the metric scale the length is 2 m., 1 dm., 1 cm., 4.57 mm., or 2,114.57 mm. The journal every body knows is $3\frac{1}{4} \times 7$ inches. That expressed in the millimeter scale is 95.25 × 177.8 mm. Every other item of shop measurement about any part of shop work would be subjected to similar strange sounding changes which workmen would learn very slowly. In the process of learning mistakes would be made, and delays in getting out work would ensue that would cost railroad companies millions of dollars. The enthusiastic advocates of the metric system say that standards would be adopted which would conform to even divisions of the meter. The proposal to change established forms to suit a new unit of measurement is simply absurd, and the men who speak of such a thing merely display their ignorance of this nation's business. Look for an hour through a well-equipped tool room. Note the great variety of drills, taps, dies, reamers and gauges that are made to standard sizes; then reflect on the thousands of shops and factories that are working to the same sizes. Look at all the lathes in the country, all of them made with lead screws arranged to cut threads to the inch or fractions thereof. No man familiar with the production of machine work who has good sense would venture to recommend that a mixed system of manufacture be introduced into a shop. You cannot have one machine cutting 8 threads to the inch and another cutting 32 threads to the decimeter, which is the nearest metric unit to the inch, for they will not interchange, and it needs few words to convince railroad mechanics that mixing bolts or nuts with threads that are nearly the same but do not interchange is out of the question. If the metric measurements should be introduced and old standard sizes retained, it would lead to great increase in calculations through the large number of figures necessary to express common sizes. To introduce the metric system with standards based on the metric or millimeter unit, it would be necessary to discard all existing standards. This could not be done by degrees. It must be done at one fell sweep. The blind advocates of the metric system see no difficulty about abolishing all standards and beginning the world of sizes anew; but the men who are responsible for keeping railroad rolling stock running at the least possible expense are not likely to fall in with any such impracticable scheme. We have merely touched the edge of the difficulties that would be encountered in changing our system of metrology. We would like to learn a single advantage which railroad shops would derive from a change of the kind. We fail to see what benefit it would be to our railroad companies to have the French measurements used in the construction and repair of their rolling stock. For some purposes decimal measurements are highly convenient; but for machine shop practice, the binary division of the inch is more convenient than any other.

The shortcomings of the metric system as applied to machine shop practice have been admirably explained at various times by Prof. Coleman Sellers. Fifteen years ago he read a paper on the subject before the American Railway Master Mechanics' Association, and it was still more fully elucidated in a paper read before the American Society of Mechanical Engineers in 1880. We commend the careful study of these papers to any one who feels moved to introduce the metric system into a railroad shop.

Progress of Continuous Car-Heating.

Car heating with steam from the locomotive was to a great extent experimental last winter, and the severe weather did little more than demonstrate what was wanted to keep cars warm under the varying climatic conditions of train service. The companies operating the various systems of continuous heating of cars made good use of the lessons that the experience of a fairly severe winter taught them, and the opening of this season was met with many improvements culculated to make failures unlikely. In one sense it is unfortunate that the winter has been so mild, for the developed systems have encountered nothing to demonstrate weak points, and consequently the progress of development is checked for want of the guide to the pruning process which would stimulate its growth. A mild winter is also apt to reduce the dangers from heating by stoves, and railroad managers are not so likely to feel much concerned about the safety of passengers crowded in cars that need very little fire to heat them to a living temperature; and as a result the progress in favor of safe means of heating languishes more than it would do if danger were more imminent. In spite of these encouragements to apathy, however, this winter has seen a decided advance in favor of steam heating. Nothing succeeds like success, and the absence of difficulty in satisfactorily heating the many passenger trains already equipped with good systems of continuous steam heating has exerted a proselytizing effect upon many railroad managers who were formerly skeptical about the practicability of the locomotive supplying steam to heat a through train of cars.

A curious circumstance connected with the popular agitation in favor of safe methods of car heating has been the publication, by the Railroad Commissioner of Michigan, of a circular taking strong grounds against the use of steam for car heating. If it was not for the profound density of the ignorance about steam and railroad matters displayed in the circular, a reader might readily conclude that it was written by one of the railroad managers opposed to any change from the murderous stove. What to many would be regarded as a counterpoise to that circular, was an accident at Tallmadge, O., where a passenger train ran into a stalled freight with disastrous results. The wrecked passenger cars took fire from the stoves, and six persons were cremated. This is an object lesson that goes home where reason and impassioned appeals would be unheeded.

The proceedings of the last meeting of the Western Railway Club constitute an interesting chapter on the present condition of the problem involved in the heating of cars by steam. The papers read and the discussion that followed effectually covered the whole subject. Both sides of the question in its mechanical aspect were thoroughly and earnestly discussed by practical men, familiar with every detail, determined to tell the truth no matter who might be hurt or offended. No shortcomings appeared to be overlooked, present or prospective, and the difficulties in the way of perfection were not underrated. The inference to be drawn from what was said is, that the various systems of steam-heating work as satisfactorily as any new appliances of a complex nature have ever done when first introduced into train service. The greatest difficulty incident to the new system of heating, as experienced by many railroad officers, is the dealing with the steam-heated cars when they are detached from the locomotive. This is, however, a detail whose magnitude exists in inverse ratio to the energy and fertility of resource displayed in overcoming it.

To the traveler some objections are presented to steam heating, as at present regulated, which have not received much attention in the public discussions. Perhaps the mild weather of the winter is principally to blame, but we have all found that the temperature of steam heated cars has been kept too high, and the perfunctory efforts of trainmen at regulating the heat has led to rapid changes from heat to cold and back again to heat, which are very trying to weak constitutions, and cause discomfort to the strongest. Some automatic means of ventilation to operate along with the action of the heaters is urgently needed, or appliances that would regulate with exactness the quantity of steam

necessary to supply the required degree of heat. This will come in time, no doubt, but in the meantime the trainmen ought to have the aid of thermometers to indicate the temperature inside cars, and strict injunctions to use their best efforts to regulate the heat would not be amiss. Automatic regulators and well trained trainmen will do much to reduce the discomforts of travel, but there are some seeming sources of inconvenience that nothing can remedy. The writer met with a good illustration of this during a recent journey in a steam heated car. The temperature appeared to have kept rising until he felt like being in the hot room of a Turkish bath, and he had just made up his mind to ask the porter to open the ventilators. But just as he was about to speak, a gentleman near shouted in a querulous, complaining voice: "Say, porter, do you intend to have us freeze to death in this car, why don't you close the ventilators"? What can a trainman do to reconcile the demands of people with such diverse tastes?

Settlement of the "Q" Strike.

After a struggle that lasted on one side for more than ten months, the strike of engineers on the Chicago, Burlington & Quincy Railroad is declared by the leaders of the strike to be at an end, and any of the men who have held out so long may return to work without fear of being branded as "scabs" if they can induce the company to employ them. Through a change made in the Constitution of the Brotherhood of Locomotive Engineers at the Convention held in Chicago in October, 1887, the authority to declare a strike off was taken away from the Grand Chief Engineer of the organization, and vested in the Grievance Committee of any railroad where a strike might take place. Every man with common sense who had opportunities of observing matters on the Chicago, Burlington & Quincy and was not influenced by the passions that taking part in the strike engendered or was not interested in protracting a struggle that led to the disbursing of large sums of money, could not fail to perceive that the strikers were thoroughly beaten two weeks after the strike began. Had one responsible officer controlled the power to declare the strike off, sense of duty and justice to the men likely to lose their places would have compelled him to accept the best terms that could be obtained from the company. Instead of that the responsibility of admitting and accepting defeat was left to a large committee, the members of which had been to a great extent instrumental in precipitating the conflict. Their numbers dissipated the sense of individual responsibility, and the collective courage was kept up by frequent meetings where fiery harangues were made against the officers of the railroad company. Unreasoning shouts that victory would be the certain result of persistence kept the wavering from giving in, and held up the strike long months after defeat was complete.

As late as July last, the officers of the Chicago, Burlington & Quincy tried to reach the conservative element of the Brotherhood, and intimated that they would take back all their old engineers that they could find employment for, and it is certain that 50 per cent. of the old men would have got the places they had left. But no one had authority to accept the terms except the Grievance Committee, with Chairman Hoge as a mentor, and they declared that the Chicago, Burlington & Quincy must take back all their old men and discharge those who had taken the places of the strikers, and that a settlement could not be effected on any other basis. With such senseless or corrupt men in control, nothing more could be done till this committee met their masters at the next convention. Accordingly at the Richmond Convention, held last October, the power to settle the strike was put into the hands of a new committee, of which Mr. A. R. Cavner was chairman. After nearly two months of an investigation, this committee admitted that the men were beaten, and officially accepted the terms offered by the company, which read as follows:

"The company will not follow up, black-list, or in any manner attempt to proscribe those who were concerned in the strike, but on the contrary will cheerfully give to all who have not been guilty of violence or other improper conduct, letters of introduction, showing their records in our service, and will in all proper ways assist them in finding employment. The first duty of the management is to those who are in the company's employ, and we must remember and protect their interests by promotions and by every other means in our power. Beyond this, if it should become necessary to go outside of the service for men in any capacity, it is our intention to select the best men available, and in making selections not to exclude those who were engaged in the strike of Feb. 27, if they are the best men available and provided they have not since been guilty of violence or other improper conduct."

That may not mean unconditional surrender, but to us it reads as near it as anything we know; yet accepting the terms was the only thing that could be done, for the company's officers were in the position to be quite indifferent whether the strike was declared off or not. And a pretty finish it is to the shouting of the agitators whose influence prevented fifty per cent. of the engineers and firemen belonging to the great "Q" system from going to work last July, and now sends them out to seek for work in an overstocked labor market.

The demoralizing weakness of the Locomotive Engineers Brotherhood is, that it is running too much into committees. A great many men would rather spend their time working on and up grievance committees than in trying to do their work decently, and those noted for doing their duties badly are generally most zealous in finding work for grievance committees to do. The affairs of the organization were much better conducted before grievance committees were instituted than they have ever been since these organs of agitation were established. A grievance committee is very ready to manufacture grievances if none are at hand ready made. They are a very convenient means for giving natural agitators the opportunity of lobbying in the offices of general managers and master mechanics; but they effect no real good at any time, and in cases of trouble inflict the worst kind of tyranny and oppression on the men whose interests they pretend to serve. Every engineer and fireman who had good positions last winter on the C., B. & Q. system, and is to-day, owing to the strike, looking for work, is a living sacrifice to the iron hand of the grievance committee.

The Webb Compound Locomotive.

The Pennsylvania Railroad Company have had a compound locomotive built in England according to the patents held by Mr. F. W. Webb, locomotive superintendent of the London & Northwestern Railway, and it is expected that the engine will soon be received and put in service. The Webb compound locomotive is doing very good service in England, and there is no reason why it should not be successful on our railroads, except that our limit of economy due to intelligent and skillful operating is not nearly reached with simple locomotives. So long as a large proportion of our locomotives lose the direct advantage due to the use of high pressure steam through the prevailing practice of throttling the steam till 25 per cent., more or less, of the boiler pressure is lost, there is little use in introducing compounding or any other complex method arranged for taking more work out of the steam than is obtained in ordinary operating. The economy due to compounding is highly desirable, but the first duty of our railroad men is to use greater efforts to obtain the maximum measure of economy out of the high pressure locomotive.

The Webb compound locomotive has three cylinders, two for high pressure steam and one for low pressure. The high pressure cylinders are placed outside the frames in about the position of the guides of our American locomotive, and the connecting rods from them take hold of crank pins on the back drivers. The low pressure cylinder is under the smoke-box, and it transmits power to a crank axle of the leading driving wheels. There are no side rods, and this is reputed as a merit in the engines, since there is no fear of the accidents that sometimes happen from the breakage of side rods or their connections. Through the absence of connecting rods, the rotation of the two pairs of drivers is not synchronal, and consequently the low pressure cylinder does not do its work in unison with the other cylinders. Owing to this, it sometimes happens that the low pressure piston is exerting its greatest power at the instant when both the high pressure pistons are exerting their greatest rotative power on their driving wheels. If this happens when the engine is working hard it causes a jerky action similar to that of an ordinary locomotive working with one side disconnected. This peculiarity may prove very awkward in a locomotive pulling an American passenger train, where persons are constantly moving about, for it is severe enough to throw people off their feet.

We believe that for American service the Webb compound locomotive would be improved if the drivers were connected by side rods and the cranks set 120 degrees apart. The spread of the wheels is not so great as that of many of our locomotives that are run with perfect safety; then there appears to be a rotational gain in setting three cranks at equal distances apart. In discussing a paper on triple expansion marine engines recently read before an English engineering society, it was pointed out that in two ships alike in every respect except that one has two-crank other three-crank engines, the consumption of coal per indicated horse-power is precisely the same, but that the three-crank engine drives its ship half a knot, or 5 per cent., faster than the two-crank engines. This is a very important point, and one which has not been sufficiently dwelt on by marine engineers, because in discussing the relative merits of the two and three-crank engine it has been practically limited to comparing the consumption of coal per indicated horse-power. The same feature would also be very likely to give an advantage to the Webb compound locomotive and its importance certainly recommends it for a practical trial.

Boiler Explosion on the Pennsylvania Railroad.

There was a very disastrous explosion of the boiler of a locomotive belonging to the Pennsylvania Railroad at Blairsville shops on Jan. 21. One man was killed and two were severely injured. According to the meager accounts we have received of the occurrence, the explosion happened to a new locomotive boiler which they were testing under steam. This is a very dangerous practice, although it is a very common one, and the men who follow it are guilty of criminal recklessness. Although nearly all well-made boilers are perfectly able to stand with safety the pressure they are calculated to carry, it is not a safe practice to fire up the boiler and raise sufficient steam to make the test which will demonstrate its strength. There is always the remote danger of some unseen flaw, like a weak link in a strong chain, and the weak point really gauges the strength of the boiler. The test of hot water expanded to give the safe limit of pressure will always lead to the detection of a defect that makes the boiler dangerous, and there is really no excuse for neglecting to make such a test before the boiler is subjected to the working pressure of steam. An explosion of a new boiler, or of one that is newly overhauled, is such a rare occurrence that the men responsible are nearly always inclined to act as if a hot water test was a useless precaution and an unnecessary waste of time and labor. Those who make this the rule of their business are not acting fairly towards the company they serve, and they habitually put the workmen in their shops into a position of unnecessary danger.

Train Dispatching.

A Minneapolis paper having published some venomous remarks about train dispatchers and the way their duties are usually performed, Mr. Fred. W. Faulkes, editor of the Cedar Rapids *Gazette*, who was for years a railroad telegraph operator, vindicates the train dispatcher in a vigorous fashion. Fred is nothing if not energetic. He says "running a newspaper, or any other kind of business, or any other department of a railroad, is simply a picnic, an unceasing round of joy and pleasure, as compared with the duties of a train dispatcher. Upon his shoulders rest greater responsibilities than upon any other man in the service. He is under a strain all the time, and to move hundreds of trains on a single track, make them meet and pass one another, running specials and extras and work trains, and all that, and engineer them all in safety, and at the same time arranging so that no time shall be lost by any of them, that all connections may be made, and to continue that work day in and day out, is 'old business.' It is very seldom indeed that a train dispatcher or a telegraph operator makes a fatal error in a train order, and then the dispatcher is not oftener to blame than the officials who prepare the form of order. The telegraph operators who make 'bulls' are usually the cheap 'plugs' that are incompetent, and are employed simply because they are cheap."

A shipment of cattle was recently made from a point in Idaho, and the animals were sent right through to New York without being moved out of the cars. They were transported in patented stock cars, where they were fed and watered. On some of the roads west of Chicago an average speed of over thirty miles an hour was maintained, but east of Chicago the speed was cut down to about fifteen miles an hour. In spite of the slow moving towards the end of the journey the stock came through the 2,500 miles of the trip with a loss of about ten pounds per animal, and they were all in fine healthy condition. Efforts have been made to arrange for accelerated speed on eastern roads for future shipments of live stock, but there is great difficulty in getting any railroad management to run freight trains over their roads at a fair speed, even although all the cars are equipped with air brakes and excellent running gear.

We have received through General Passenger Agent Lee, of the Colorado Midland, a Christmas present in the form of a neatly arranged catalogue of minerals found in the mountains traversed by the Colorado Midland. The specimens of minerals are very well selected, and an examination of them is likely to inspire the mineralogist and prospector to hie for the land where such riches are to be found. But minerals are not alone the attraction found on the route of the Colorado Midland. The circular which accompanies the minerals directs attention to wonderful salt springs at Glenwood, which provides baths as invigorating as a plunge in the ocean. We can personally testify to the magnificent scenery through which the railroad winds its tortuous way.

There are several first-class master mechanics and master car builders who are at present open to an engagement. If any general manager or superintendent of motive power is in want of an officer to take charge in any of the departments mentioned, we should be glad to supply the names of men well fitted for the position. If any of our readers know of vacancies they would confer a kindness by advising us of the particulars.

The New Wales Railway and Tramway Review is the name of a weekly journal published at Sydney, N. S. W., in the interests of the Amalgamated Railway & Tramway Association of employés. The paper is very well edited, and while first advocating the rights of the class it represents, gives the railway and tramway news in an attractive and well-condensed shape. Mr. W. F. Schey is editor and manager.

Personal.

Mr. John Black, long well and favorably known as Master Mechanic of the Cincinnati, Hamilton & Dayton, has been appointed Master Mechanic of the Chicago & Atlantic, with headquarters at Huntington, Ind.

Mr. Walter A. Jones, one of the proprietors of the Jones Car Works, of West Troy, died of consumption Jan. 2, at Saranac Lake, N. Y. Mr. Jones has been prominently connected with several street railroads throughout the country.

Mr. D. B. Robinson, who is well known through his connection with the management of the Mexican Central, the Atlantic & Pacific and the Colorado Midland, has been appointed assistant general manager of the Atlantic & Pacific, with headquarters in Boston.

Mr. S. T. Wellman, the noted metallurgical engineer, who has been for twelve years superintendent of the Otis Steel Works, Cleveland, has resigned on account of impaired health. It is understood that Mr. Wellman will go to California to recuperate.

Mr. John B. McDonald, the contractor and builder who constructed the approaches to the Arthur Kill bridge, has been chosen president of the South Baltimore Car Works, vice Mr. William Keyser, resigned. Mr. McDonald is a member of the railway contracting firm of Ryan & McDonald.

Mr. Roswell Miller, president of the Chicago, Milwaukee & St. Paul, has returned to Milwaukee after a two months' trip to Europe. We understand that one result of Mr. Miller's trip abroad is that the foreign stockholders are now willing to wait till the road earns the money before they combine to compel the payment of dividends.

Mr. F. W. Coolbaugh has been appointed secretary in the American Live Stock Express Company, with headquarters at 45 Broadway, New York. Mr. Coolbaugh, who was for years an officer of the Delaware, Lackawanna & Western, has been for some time general agent of the Boies steel car wheel, a position he retains.

In connection with an order for new passenger cars given out by the Baltimore & Ohio Railroad to one of our leading builders, a high compliment was recently paid to Mr. E. W. Grieves, Master Car-Builder of the road. Mr. Grieves furnished the drawings and specifications, and they were declared to be the most complete in every particular of anything of the kind that had ever accompanied an order for cars.

Mr. William Voss, Assistant Master Mechanic of the Burlington, Cedar Rapids & Northern, and author of the articles on Railway Car Construction running through our columns, has accepted the position of Assistant Engineer of the Fox Solid Pressed Steel Company, with headquarters in Chicago. Since he began writing for us Mr. Voss, who is one of the ablest men in his line in America, has received several inquiries if he is open for another engagement.

We have repeatedly heard rumors that Mr. John W. Cloud, who lately resigned the position of superintendent of motive power of the Erie, was going into commercial business. We are assured that there is no truth in any reports of the kind. Mr. Cloud is a very able mechanical engineer, with the kind of training that will make his services of great value to any progressive railroad company, and his intention is to return to the business when opportunity offers.

Mr. George W. Cushing, who has been living in Chicago since he resigned from the Philadelphia & Reading last July, has been appointed superintendent of motive power of the Union Pacific, in place of Mr. Clem. Hackney, resigned. Mr. Cushing, as most of our readers know, is one of the most successful railroad mechanical officers, being particularly noted for his ability as an organizer. He learned the machinist trade in the Union Locomotive Works, Boston, and in 1854 went West. His upward progress was rapid, and in 1861 he was made division master mechanic of the Chicago & Northwestern. Among the positions he has held since that time were superintendent machinery Kansas Pacific, superintendent machinery Wabash Railway, general superintendent Denver & Rio Grande, and superintendent motive power Northern Pacific.

Mr. Samuel M. Felton, of this city, whose death has just been announced, was a master in all that pertains to railway construction and railway management. He knew that business, from the laying down of the lines and planting the stakes as surveyor and engineer, from the construction and equipment of the road after construction, all the way through to the administration of the multifarious details of great lines of traffic and travel. His life was spent in that work almost from the day of his graduation at classic Harvard, where he was a conspiciously able student, down nearly to the day of his death. It was a life of great usefulness—quiet, most modestly unobtrusive—yet commanding always the admiration and respect of his colleagues and coadjutors in the guild of strong intellects who occupy the front rank of American "railroad men." He was an unusually accomplished man in the "humanities," gifted with strong, good sense besides, to keep companionship with his genial manners and gentle disposition. His eighty years of life having been well spent, he is one of those who die without regret, yet regretted by all who knew his sterling character.—*Philadelphia Ledger.*

The article on Combustion in Locomotive Fire-boxes, published in another part of this issue, was written at the suggestion of Mr. E. B. Thomas, vice-president of the New York, Lake Erie & Western, and has been put in pamphlet form for the instruction of the enginemen of that road. The pamphlet can be procured at this office for 25 cents a copy. The following notice has been sent with the pamphlet:

NEW YORK, LAKE ERIE & WESTERN RAILROAD CO.
OFFICE OF THE SUPERINTENDENT OF MOTIVE POWER, }
NEW YORK, Jan. 15, 1889. }

Mr......

Fireman of Engine No. ..... *N. Y., L. E. & W. R. R.*

DEAR SIR: I take pleasure in presenting to you, with the compliments of the company, this treatise upon the consumption of fuel by locomotives, which has been prepared by Mr. Angus Sinclair, the author of several works on locomotives, editor of the NATIONAL CAR AND LOCOMOTIVE BUILDER, secretary of the Master Mechanics' Association, and for many years a locomotive engineer.

The economical and efficient consumption of fuel is one of the most important objects to be considered in operating a railroad, and the fireman who gives it the closest attention produces the best results. It is the policy of the company to promote its firemen to engineers as rapidly as the service admits of it, and the record made by each fireman in handling fuel will have great weight in selecting men for promotion to the position of engineers. This treatise has, therefore, a personal interest for each fireman, and I trust that you will study it carefully and endeavor to profit by the information therein given.

Yours truly, ROSS KELLS,
Superintendent of Motive Power.

We have several times within the last two months received letters of inquiry from enginemen as to what prospects there are for their obtaining employment on the new railways about to be built in Chili by an American company. We understand that the company are not looking for any help yet, and will not require men for some time. Men anxious to find out full particulars should apply to the South American Construction Company, Broadway, New York; but we would earnestly advise American trainmen to stay in this country, for they will only meet with disappointment in South America.

The proprietors of that highly enterprising journal, *The Tradesman*, of Chattanooga, Tenn., have compiled a highly interesting table of the growth of the South during the past year. From this table it looks as if our Southern friends were going to have a largely increased railroad mileage in the near future, for no less than two hundred and fifty-three new railroad companies were formed within the year. There were twelve companies formed to build cars, and one hundred and forty-five new companies have erected or propose to erect foundries and machine shops.

Cast Iron Wheels.

At the January meeting of the New York Railroad Club, Mr. W. T. Hildrup, of the Harrisburg Car Manufacturing Company, and Mr. Lobdell, of the Lobdell Car Wheel Works, Wilmington, read papers on cast iron car wheels. A great many points connected with the manufacture of car wheels were discussed in the papers. The statements made were discussed at great length, mostly by practical wheel makers. Among the speakers were Messrs. C. T. Chapin, C. A. Smith, Raber, Lobdell, Hildrup and Garey.

Severe Test of a Friction Buffer.

On last Wednesday, at the Pennsylvania Railroad car shops at Altoona, a very important test was made to determine the effect of the Westinghouse friction buffers when applied to freight cars, as well as the relative endurance of the buffers and the freight cars themselves. Two Pennsylvania Railroad gondola cars had been fitted with friction buffers for the purpose of this test. The cars were old and weak, and it was intended that the test should be so severe as to make them unfit for further service. The tests were conducted as follows: The two cars were set on a piece of straight track and the brakes on one firmly set; an engine hauled the other back and then gave it a shot down the track, so that it came into collision with the standing car. Fourteen such tests were made. In the first the moving car had a speed of about 5 miles per hour; in the successive tests, up to and including the eleventh, the speed was gradually increased, until, in the eleventh test, it reached 25 miles per hour. In the twelfth test, at a speed of 28 miles per hour, some of the blocking back of one of the buffers was smashed by the concussion, and one of the car trucks broke loose from its fastenings, and stripped the body bolster. This was due to the momentum of the heavy truck, and the sudden stoppage of the car body. On the fourteenth test, a speed of 30 miles per hour was reached, with the result that one center sill on the moving car was cracked, near the body bolster, and both center sills of the fixed car were cracked at the same place; the drawhead of the fixed car was also broken in the shank; the bolsters under both cars were partially stripped from their positions. The buffers, however, remained intact and uninjured. The two cars were so badly used up as to be unfit for further service, while the buffers will be transferred to other cars, and continued in service.

The fact that two such old cars could be run together at a speed of 30 miles an hour without utterly demolishing them has conclusively proven the efficiency of the buffers to absorb momentum without serious shock to the structure. These buffers will, theoretically, take up a momentum six and one-half times as great as can be absorbed by an ordinary draft rigging, when in perfect condition; but, in fact, owing to the average loose condition of the draft gear of most ordinary cars, these friction buffers will absorb and take up from 12 to 15 times the momentum which ordinary draft rigging will take care of.

The test was considered a great success, as it demonstrated conclusively not only the capacity of this new friction buffer to absorb momentum, but the great strength of construction of the buffer and its attachment to the car body.—*Pittsburgh Dispatch.*

Messrs. John Wiley & Sons, New York, the well-known publishers of scientific books, have issued a list of the new books published by them in 1888. It contains a great many books that progressive railroad men ought to read, and those interested in writings connected with their business cannot do better than apply to the publishers for the list.

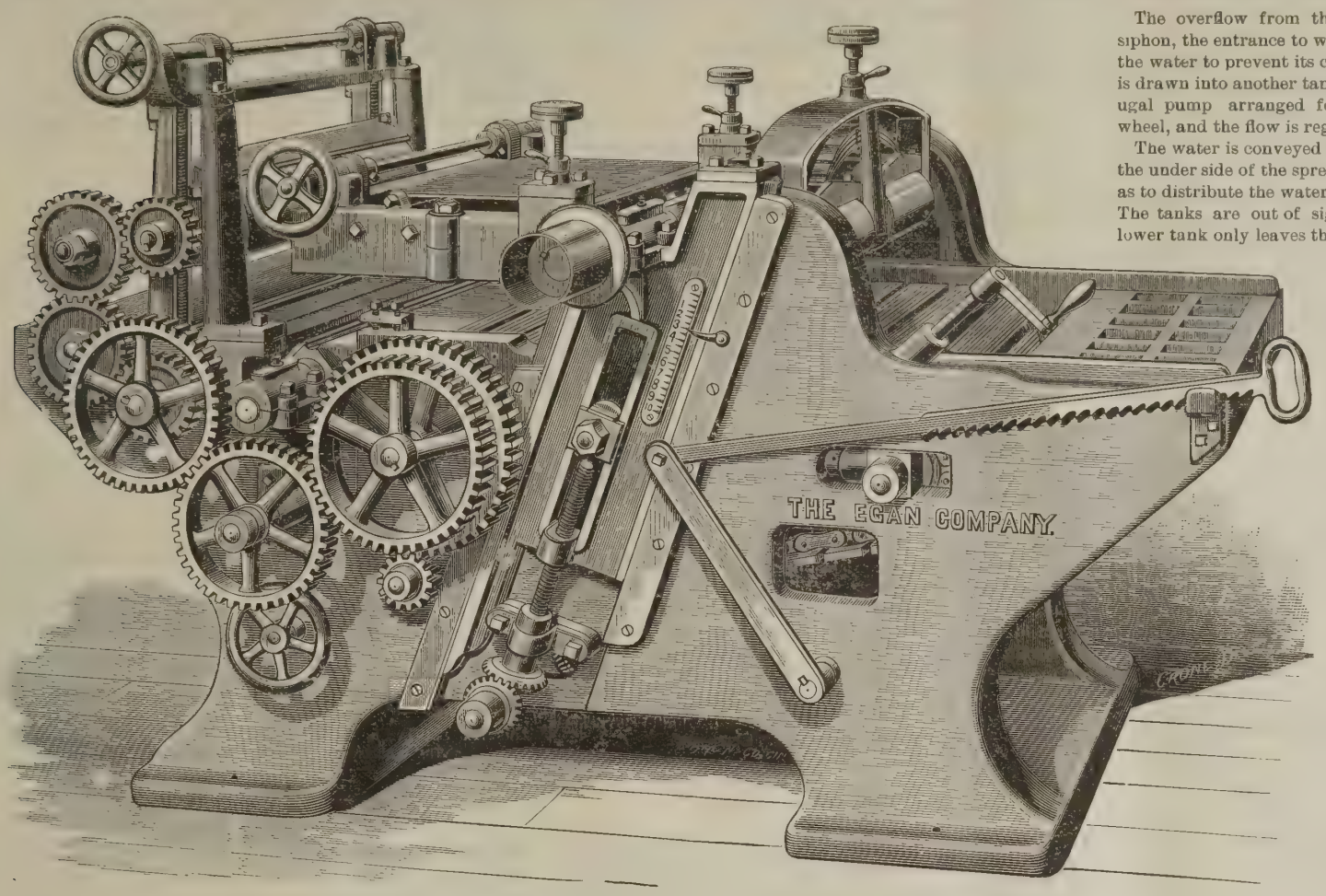
Messrs. Long & Co., Pittsburgh, write us: We desire to advise you that we have taken the general agency for conducting the outside business of the Marks Automatic Car Coupler Company for the United States, and hereafter all correspondence and all sales contracts will be attended to by us, and inquiries and orders should be sent to us at our office, Hamilton Building, Pittsburgh, Pa. We hope to be favored with your future valued inquiries and orders.

Since the Crosby Steam Gauge and Valve Company built their new factory at Charlestown, by which facilities for manufacturing their specialties were greatly increased, their business has increased in like proportion; and to meet this growth, and in anticipation of its continuance, they have enlarged their salesroom and office at 93 Oliver street, Boston, by adding a large portion of the adjoining store. The English business of the company is rapidly increasing, and Mr. Geo. A Mower, their London manager, is now in Boston, perfecting plans for a larger output of the Crosby indicators and other instruments especially adapted to meet the requirements of English engineers and machinists.

An illustrated circular has been issued setting forth the merits of the Cooke locomotive bell ringer manufactured by Cooke & Strong, Danville, Ill. Numerous testimonials certifying to the high value of the device are also published. The leading points made for this bell ringer are that it is simple in construction, has but few parts, can be used with either air or steam; is positive in its action, can easily be adjusted, is compact and symmetrical in design; can readily be applied to any engine at a very little cost. An engine equipped with such an apparatus, covers several points in law, the engineer is not liable to say his attention was attracted to something and that he was unable to ring the bell, while the fireman was putting in coal.

The Joseph Dixon Crucible Company (Crucibles, Graphite Paints, Pencils and Lubricants), Jersey City, N. J., write us: The year 1888 was chiefly notable with us for the large increase in the business of graphite specialties made by us, such as silica graphite paint, graphite pipe joint grease, graphite grease, and this verifies a prediction made by us years ago, that graphite would prove to be one of the greatest smaller articles in the arts. The total amount of business done by the Dixon Company in 1888 is larger than in any previous year. We have had to increase our plant by putting in one large new black lead mixer, one large paint mixer, and one 100 H. P. steam boiler. We are heating a large portion of our buildings here by exhaust steam, having equipped for that purpose. We see no reason why 1889 should not bring everybody in the United States good times. Where a nation of sixty million wide-awake, energetic people are gathered together under a million and one factory roofs, managed chiefly by younger men, educated in our best scientific schools, it promises good for the future.

In the manufacture of belting St. Louis is far ahead of any other city, not, perhaps, in the quantity of belts made, but in the quality; and as the quality becomes thoroughly understood the quantity increases, so much so that one large factory here is supplying and has supplied belting which is running machinery in every part of the United States, and a very considerable amount in foreign countries. The concern alluded to is the Shultz Belting Company, who manufacture the patent of Mr. Shultz, which consists of leather tanned on the surface only; the interior of the hide, which is the fiber, is raw hide softened and made pliable by this patent process. The grain is very soft, like kid, which causes it to adhere to the pulley, and this, combined with its great strength and pliability, gives it its wonderful driving power. For machinery running at high speed, where there is great strain, or on a twist, or for any machinery requiring the full extent of the engine power, the Shultz patent fulled-leather belt is unquestionably the superior by far of any belt yet put before the trade. The cost, of course, is something more at first, but when the life of the belt is considered, together with its driving qualities, and the fact that they require no amount of taking up, consequently no loss of time, the Shultz belt is much the cheapest belt made. The company are also large manufacturers of rawhide, lace and picker leather, and their total output is increasing rapidly each year, and their trade extends wherever machinery is used.—*St. Louis Paper.*

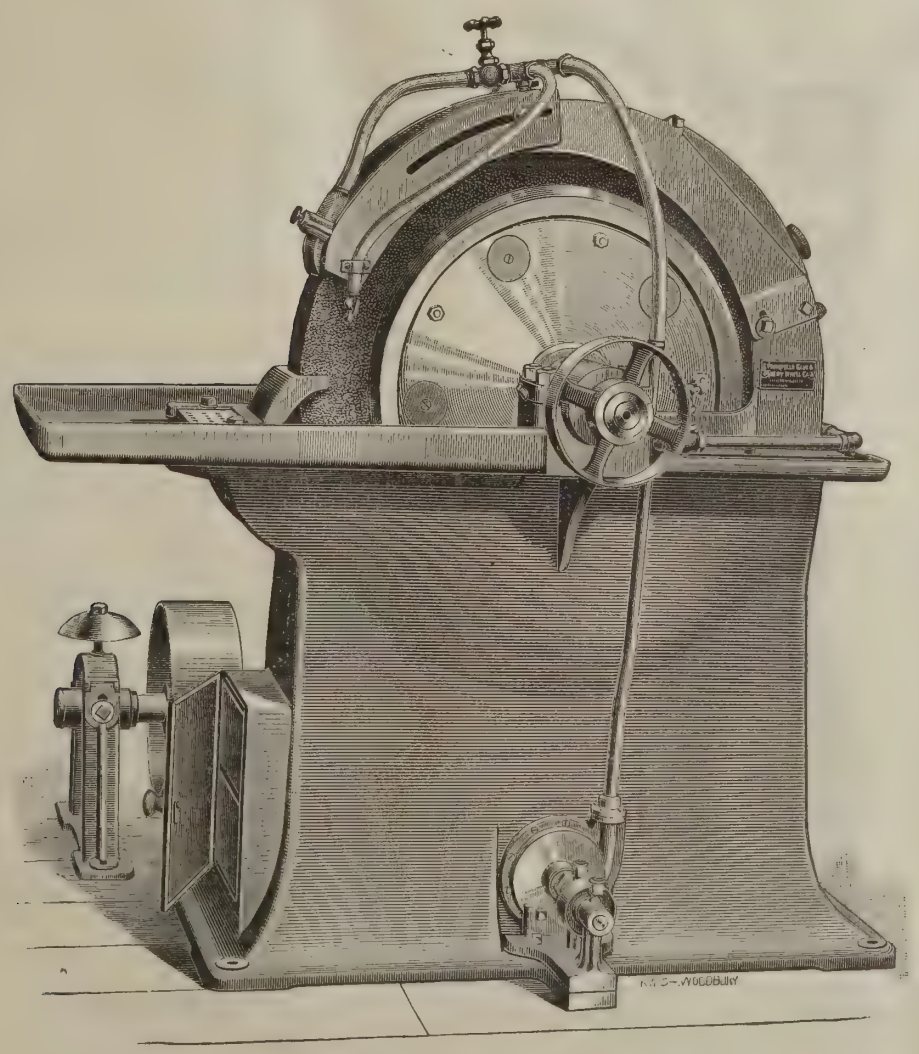


DOUBLE CYLINDER ENDLESS BED OR FARRAR SURFACER.

We present to our readers an illustration of a recently improved double surfacer with cylinder to raise and lower, and with a pair of feeding-out rolls for the lower cylinder. The frame is of new design, and is made in such a way that it is exceedingly strong for its weight, as it is braced and ribbed on the inside, which makes it very stiff and solid, and is so arranged that the working parts are easily got at. The main cylinder raises and lowers by a crank from the working end of the machine. This cylinder is double belted, and the lips are of the very best cast-steel and are brought up in such a manner that the knives hug them very firmly. The lower cylinder is on a standard bed and has an independent adjustment for a heavy or light cut. The feed on the machine is very powerful, and the board is fed entirely through without the aid of the operator. The feeding rolls for feeding out the board are geared in the most superior manner, and make a very powerful feed which takes the board entirely through the machine. This will be found a great convenience. The pressure rolls are firmly weighted and hold the board solidly on a traveling bed. The bed frame being stationary, the slats are gibbed in the most improved manner, so that by no possible means can the ends of them be thrown into the cylinder. The broken roll is a great improvement on this machine and works on an improved principle. Two boards of uneven thickness can be fed through at the same time.

The manufacturers build two sizes of this machine, one to plane 26 inches wide and 10 inches thick, and the other to plane 30 inches wide and 10 inches thick. The builders recommend this machine very highly for first class planing mills, large furniture factories, car and railway shops, and all parties having large quantities of wood to dress on either one or both sides.

For further information address the builders, the Egan Company, Cincinnati, O.



IMPROVED EMERY WHEEL TOOL GRINDER.

The Springfield Glue and Emery Wheel Company are at present turning out a new and important form of grinder which possess many advantages for all uses to which this important tool is put.

As will be seen by the accompanying illustration, it is a very heavy and substantially built machine, capable of doing the heaviest work without flinching or vibration, the base being sufficiently flaring to give it a good foundation on the floor.

The tank for receiving the water as it comes from the wheel is placed inside the iron frame work, and this also catches the waste emery as it is ground off. This tank can be easily withdrawn when necessary to empty it.

The overflow from the tank is taken away by means of a siphon, the entrance to which is far enough below the surface of the water to prevent its collecting any oil or scum, and the water is drawn into another tank below, to which is attached a centrifugal pump arranged for carrying the water back upon the wheel, and the flow is regulated by means of valves.

The water is conveyed to the wheel through a small opening on the under side of the spreader, which is of brass, and so arranged as to distribute the water evenly over the surface of the wheel. The tanks are out of sight, and the pump connection with the lower tank only leaves the upper tank free from pipe connections, so that it can be readily emptied without having to make connections.

The table is pitched toward the center sufficiently to prevent any water from standing upon it.

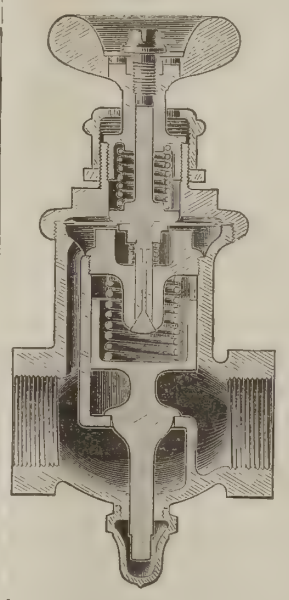
It has self-oiling bearings, 8 inches long. The spindle is 2¾ inches, and made of steel capable of carrying a wheel 36 inches in diameter and 4 inches thick, with a 24-inch hole. Large collars hold the wheel in position. Owing to the large hole, there is no wheel hub or center to be thrown away after the wheel has been worn out. By the arrangement of the collars, the wheel can be quickly and easily removed and another substituted.

The rapid increase in improved methods of emery grinders is an object of considerable consequence to users of the tool, and the above machine presents features that are certainly desirable and worthy of consideration.

At this season of the year, when so many people issue calendars both large and small, but mainly for the purpose of being hung up in the office, it is a very agreeable change to find some one enterprising enough to reverse the usual order and get up something that can be carried in the pocket. Messrs. Drake & Wiers, of Cleveland, O., have done this; they are sending out a calendar in the shape of a very neat diary or engagement book, of a convenient size for the vest pocket.

Improved Curtis Pressure Regulator.

We present to our readers to-day an illustration of an improvement upon the well known Curtis pressure regulator, by which the requirements of railroad service are met in a simple and satisfactory manner.



The operation is as follows: When the engineer connects with a cold train, he turns down on the top handle as far as he can, and leaves the regulator to take care of the pressure, assured he will get no more than 50 pounds in the system.

When the train is hot, he turns back on the handle as far as it will go, and the regulator adjusts the pressure to, say 10 pounds, the normal amount required to keep the train hot; he can make this minimum *more* or *less* in one moment, by starting the lock-nut and screwing the sleave down or up, but when once the sleave is set and clamped, the top handle can be *locked* by a hard turn against the shoulder, so that no jarring of the engine will disturb it.

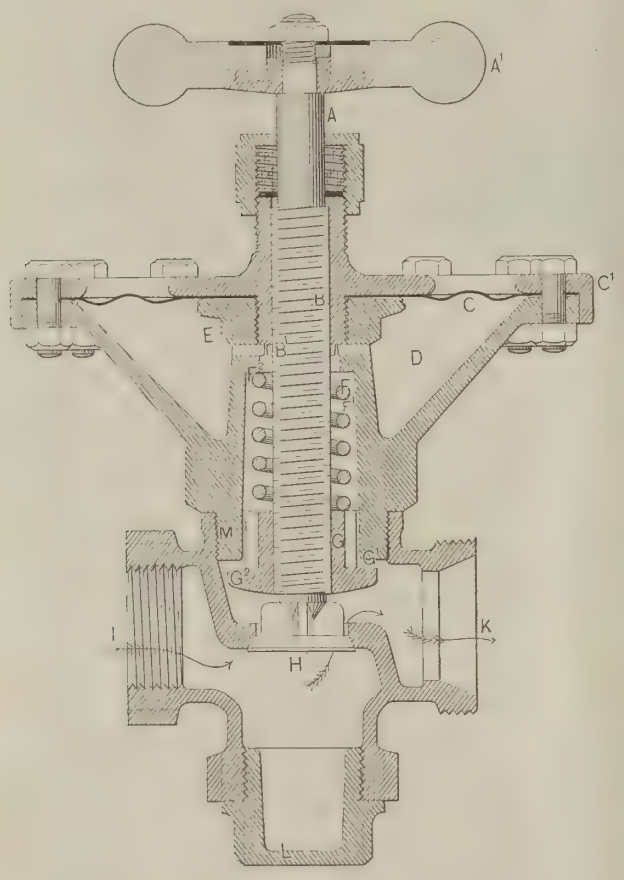
It is obvious that the engineer can set his pressure either way in the dark and make no mistake, and the same movement *fastens* the handle firmly in its place. These valves are made with outlets from 1 to 1½ inches pipe thread to engage with different sized steam fittings, and are made and sold by the Curtis Regulator Company, of Boston, Mass.

The Dunham Manufacturing Company, sole agents for the Globe ventilator, report sales since Jan. 1 to the Boston & Albany, N. Y. Central, Memphis & Charleston roads, and the Pullman Palace Car Company. Since Jan. 1, the storm proof door of the Dunham Manufacturing Company has been ordered by the C., C., C. & I., the Wabash Western, Jersey Central, Union Pacific, C., B. & Q., Wabash, St. Louis & Pacific, and the Milwaukee, Lake Shore & Western. The Servis railway tie plate is being largely used in new constructions on the Pacific Slope. Its great value in economy has been very strongly shown in the trials made during the last few months on roads both east and west. The Reed car replacer, as sold by the Dunham Manufacturing Company, has only to be seen to secure an order. It is considered the most marked improvement in that line that has been brought out in the last twenty-five years.

Mr. P. Leeds, master mechanic of the Louisville & Nashville, has applied for a patent on the link miller and slotter invented by him and illustrated in the NATIONAL CAR AND LOCOMOTIVE BUILDER of October last. Pedrick & Ayer, of Philadelphia, have arranged to build this machine, also the cylinder boring, facing and drilling machine invented by Mr. Leeds.

The Foster Automatic Pressure Regulator.

The steam pressure regulator illustrated in the annexed engraving was designed to meet what its inventor regards essential wants in any system of steam car heating. It is held that the best way to pipe cars is to use a good size main pipe, say 2 inches, properly insulated and jacketed, and at the middle of the car to introduce a three-way asbestos packed cock having a 1-inch side outlet, which is ample to supply any car; this cock should be so made that the steam may be cut off at either end and yet allow the steam to enter the car pipes, or, by reversing the plug, cut it off from the car; on the 1 inch side outlet of this regulator, branch pipes leading to each side of the cars and thence to the heating system. An automatic regulator, that will not vary in its delivery pressure and one that cannot become clogged or the valve stick, is an essential adjunct to this operation, first, for the regulation of the pressure on the train pipe and so arranged that it can be conveniently adjusted by the engineer according to the demand, and second, for the regulation of the steam delivery from the main train pipe to individual cars.



This regulator should be set to give a minimum pressure that is necessary to produce circulation in the car pipes, after which it should not be changed, and a simple radiator valve be used for cutting off steam between the regulator and the heating pipes.

The coil spring in the Foster Pressure Regulator is placed in a hexagon chamber under a certain compression sufficient to open the valve against a maximum initial pressure that may bear against its lower surface. The hexagon nut *G*, upon which the lower end of the spring bears, is threaded on the valve stem. The stuffing box *A*, in which the valve stem is also threaded, is rigidly connected to a flexible diaphragm *C*, so that any movement of the diaphragm is followed by the vertical movement of the valve, the stem and the nut. The stop G_1 is to prevent excessive movement of the diaphragm in case, by accident, the valve is open too much. Steam may be admitted at *I* or at the bottom, which, in the drawing, is shown closed by the plug.

The operation is as follows: Steam being turned on, the regulator valve is opened by turning the handle to the right (opposite the way of opening an ordinary globe valve) until the desired pressure is shown. The delivery pressure entering chamber *D* tends to force the diaphragm, valve and nut upward against the pressure of the spring, which closes with increasing resistance according to the degree of pressure delivered. If the initial pressure decreases the delivery pressure would also decrease, but for the fact that the instant this takes place, the diaphragm is relieved of some of its pressure, and thus releasing the tension on the spring, the valve *H* is forced open by the spring, so that the delivery pressure will remain the same by reason of the increased opening of the valve.

If the initial pressure increases, the increased pressure on the diaphragm closes the valve accordingly, thus giving constant delivery pressure regardless of any variation of the initial pressure.

It will be seen that the nut *G* cannot turn with the valve stem, but can only raise or lower with the diaphragm and stem; by this means a perfect equilibrium is maintained between the pressure on the diaphragm in one way and the resistance of the spring in the other. It will also be seen that there is absolutely no friction of parts, which is so fatal to the perfect operation of balanced valves, and that there is no possibility of the valve sticking, and that there is no small openings to become clogged or obstructed.

This regulator is now being introduced on the Pennsylvania, Northern Central, P., W. & B., and by the Pennsylvania Company west of Pittsburgh, large numbers of them having been recently sent to their various shops.

The Mississippi Glass Company, of St. Louis, have issued an illustrated catalogue showing the variety of ornamental patterns of glass which they manufacture. Many of the designs are highly artistic, and colored glass of the kind made by the company make very attractive deck lights for cars. The glass is strong, and not apt to be broken by the jar of the cars. They are made in any color or pattern to suit buyers. Parties interested ought to send for the catalogue.

The Mason Regulator Co., of Boston, have just received a diploma of excellence granted their reducing valve by the commission appointed at the recent National Scandinavian Exhibition held in Copenhagen.

Messrs. Pedrick & Ayer, of Philadelphia, Pa., have sent out their usual New Year's greeting in the shape of a calendar tablet, which will be found very useful to users of machinist's tools, as they have an illustration and description on each page of one or more of the numerous tools that they manufacture.

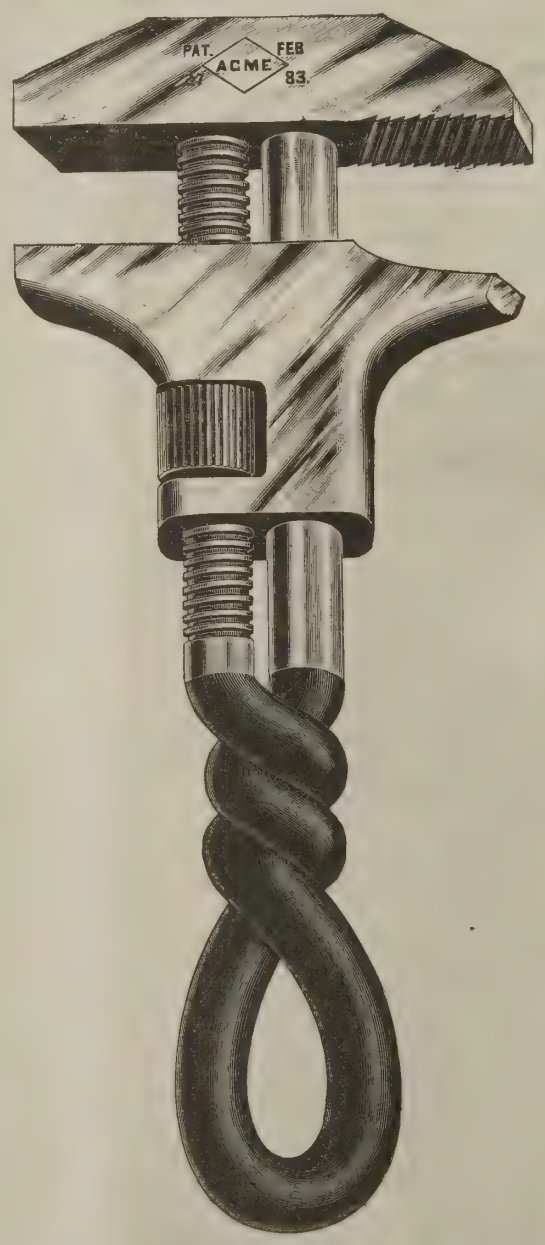
The American Steam Gauge Co., of Boston, Mass., has recently received large orders for Thompson's Improved Indicator and Boiler Attachment manufactured by them. They are to be used on the gun-boats and cruisers now being built by the United States Government. This shows with what estimation these indicators are held by the government.

Under the title of "Car Truck and Track Equipment" the Ramapo Wheel and Iron Company, Ramapo, N. Y., have issued a very handsome catalogue describing and illustrating the great variety of railway appliances manufactured by the company. The illustrations are finely done and make the catalogue interesting to look over, even to those who are not likely to be purchasers of the goods shown. The different forms of the Snow wheels are very well shown up, and their design is described fully and clearly. The different forms of brake shoes made by the company are illustrated, as is also the Raoul journal box and numerous other fittings for car work. In showing the Ramapo automatic safety, Snow's automatic safety switch stand and other track and signaling appliances, fine illustrations are given of several railroad yards. In every respect the catalogue is a great credit to the Ramapo Wheel and Foundry Company.

Acme Combined Wrench.

The Capitol Manufacturing Company, of Chicago, advise us that they have doubled their capacity for the manufacture of the improved "Acme" wrench. They have recently made great changes in the construction of this tool, and as will be seen by the accompanying illustration, it certainly suggests remarkable strength and simplicity.

The steel is made especially for their uses and warranted not to break, bend or spring with ordinary use. The head is drop forged, and great strength is secured by the double slide feature.



The long nut prevents "stripping" under the most severe strain, and, as will be seen, the length of the thread gives this wrench a greater capacity than the ordinary screw wrenches.

These wrenches are made in all sizes from five to twenty-one inclusive, both in bright and nickeled. Their special railroad wrench is made in twelve, fifteen, eighteen and twenty-one, and is especially adapted for the heaviest and roughest work.

Their combination pipe wrench is made in ten, twelve and fifteen, and possesses all the advantages of the "Standard" Acme wrench. They claim for it a wider range than any tool of the kind that has preceded it, that it is easy of adjustment, catches the pipe at once and will not crush the pipe as badly as tongs.

The American Railway Equipment Company has been incorporated for the manufacture of the Stearns patent car box and other standard railway improvements. The corporators are O. S. Burr, George G. Saxe, A. S. Hatch, Thomas R. White, Jr., O. S. Stearns, Herbert S. Ogden and Hon. William Fullerton; O. S. Burr, President; A. S. Hatch, Vice-President and Treasurer; Thomas R. White, Jr., Secretary. The capital is $1,000,000.

Our Directory.

We note the following changes since our last issue. Our readers will do us a great favor by giving us prompt notice of any changes that may come to their knowledge or of any error that may be noticed in our list:

Atchison, Topeka & Santa Fe.—Mr. G. W. Smith is appointed master mechanic, with headquarters at Topeka, in place of Mr. Thomas Downing, resigned. Mr. D. C. Courtney, master mechanic, is transferred from Coolidge to Nickerson. Mr. L. H. Waugh has been appointed master mechanic of the Western Division, with headquarters at La Junta, Col., vice J. M. Lucky, resigned.

Atlantic & Danville.—W. H. Pettibone, recently general manager of the San Francisco, Clear Lake & Humbolt, in California, has accepted the position of assistant general manager of this road, headquarters at Norfolk, Va.

Atlantic & Pacific.—D. B. Robinson has been appointed assistant general manager of the road, with headquarters at Boston.

Atlantic Coast Line.—J. R. Kenly has been appointed assistant general manager of all roads composing the Atlantic Coast Line. His headquarters will be at Wilmington, N. C.

Chicago & Atlantic.—John Black, of Lima, O., formerly master mechanic of the Cincinnati, Hamilton & Dayton, has been appointed master mechanic of this road, with headquarters at Huntington, Ind.

Duluth, South Shore & Atlantic.—Mr. J. J. Conolly is appointed master mechanic, in place of Mr. E. V. Sedgwick, resigned.

Hartford & Connecticut Western.—Mr. S. B. Opdyke has been appointed superintendent, vice Mr. E. McNeile, resigned.

Kansas City & Southern.—Mr. R. D. Blair has been appointed purchasing agent, with office at Clinton, Mo.

Louisville & Nashville.—J. G. Metcalfe has been appointed general manager, vice J. T. Harahan, resigned, and W. M. Newbold has been appointed superintendent of the South & North Alabama and Birmingham Mineral divisions, vice J. G. Metcalfe.

Missouri, Kansas & Texas.—C. N. Stevens is now purchasing agent, with office at Sedalia, Mo.

Missouri Pacific.—Mr. Clem. Hackney has been appointed superintendent of motive power, in place of Mr. O. A. Haynes, resigned.

New York, Chicago & St. Louis.—Albert W. Johnston has been appointed superintendent of the Eastern Division of the road, with office at Cleveland, O., to succeed G. H. Kimball, resigned.

New York, Lake Erie & Western.—Mr. Ross Kells has been appointed superintendent of motive power, with headquarters at New York City, vice Mr. J. W. Cloud, resigned. J. H. Murphy has been appointed master mechanic of the Buffalo Division, with office at Buffalo, N. Y., vice Wm. Litz. T. W. Ransom has been appointed master mechanic of the Western Division, in place of J. Hawthorne, resigned. Headquarters at Hornellsville, N. Y. Joseph H. Moore has been appointed master mechanic of the Delaware Division, in place of T. W. Ransom, transferred. Headquarters at Port Jervis.

Nevada Central.—C. W. Hinchcliffe has been appointe superintendent, and the road taken out of the Receiver's hands.

Northern Pacific.—Mr. C. H. Gilmour, formerly general foreman of the N. P. shops at Brainerd, has been appointed master mechanic of the Northern Pacific and Manitoba at Winnipeg.

Oregon & Washington Territory.—W. F. Wamsley has been appointed general manager of this company, with headquarters at Walla Walla, W. T.

Philadelphia & Reading.—Circulars recently issued by Mr. A. A. McLeod, vice-president and general manager, contain the following announcement: Mr. L. B. Paxson is hereby appointed superintendent of motive power and rolling equipment.

Pittsburgh, Cincinnati & St Louis.—Mr. John Commerford has been appointed general foreman of the car shops at Columbus, O.

Richmond & Danville—Mr. George D. Harris has been appointed master mechanic, with headquarters at Salisbury, N. C.

San Francisco & North Pacific.—Mr. John Dougherty, lately connected with the Western New York & Pennsylvania, has accepted the position of vice-president and general manager of the San Francisco & North Pacific and Sonoma Valley roads, with office in San Francisco.

Savannah, Florida & Western.—Mr. C. O. Haines has been appointed purchasing agent, with office at Savannah, Ga.

St. Joseph, St. Louis & Santa Fe.—Mr. J. K. Lape has been appointed general master mechanic and master car builder, succeeding Mr. M. K. Kiley, resigned.

St. Joseph & Grand Island.—Mr. Edwin McNeill has been appointed general manager of the company and its operative lines, vice G. M. Cumming, resigned.

St. Louis & Chicago—Mr. Robert J. Cavett, receiver, has assumed the duties of superintendent, vice Mr. L. S. Graves, resigned.

Sonora Railway.—Mr. Lawrence Strom has been appointed master mechanic, in place of Mr. L. H. Waugh, resigned.

Union Pacific—George W. Cushing has been appointed superintendent of machinery, with office at Omaha, Neb., to succeed Clem. Hackney, resigned.

Wichita & Western and Kingman, Pratt & Western.—D. H. Rhodes has been appointed to the position of superintendent and freight and passenger agent, in addition to his duties as chief engineer, with title of superintendent and chief engineer, and with headquarters at Wichita, Kan., taking effect Jan. 10, vice Frank M. Hill, resigned.

Employment.

WANTED—Situation as a coppersmith in a railroad shop, by an expert hand, 21 years of age. Address Robert Downer, Huntington, W. Va.

A young, pushing, active, strictly temperate railroad man of 20 years' experience, varied as draughtsman, pattern maker, car foreman, car and cab builder, desires a position as foreman of car department. Moderate salary. Good references and loyal.

Address, CAR FOREMAN,
Office of NATIONAL CAR AND LOCOMOTIVE BUILDER.

NATIONAL CAR AND LOCOMOTIVE BUILDER

MARCH, 1889.

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Miscellaneous Items

The Harrisburg Car Company are building one hundred refrigerator cars for the use of the company.

The Cincinnati, Jackson & Mackinaw are about to order 500 new box cars and some coaches and flat cars.

The St. Louis & San Francisco Railroad Company and the Louisville & Nashville Railroad Company are both about to order new freight cars from contract shops.

The Union Pacific Railway Company are getting ready for service several trains of vestibule cars, which will be run from Chicago to the Pacific Coast. Connection with Chicago will be made over the Chicago & Northwestern.

In its issue of Feb. 15, the *Railway Age* published a carefully revised statement of the new railroads constructed in the United States during the last year. The total new mileage was 7,106.4 miles.

The Iron Car Company of New York have arranged for several car building establishments in different parts of the country, to build the iron tubular car. There are over three thousand of this type of car now in use, and the demand for it is steadily increasing. The first car of the kind put in service ten years ago is still running, and has cost next to nothing for repairs.

The car inspectors of Columbus, O., have organized an association with a membership of 50, and Mr. John Drake is the secretary. We have not learned the names of the other officers. It is well that this hard working and deserving class of employés should be represented by an organization and we hope in the future to give a fuller report of the aims and objects of the Columbus Association.—*Railway Service Gazette.*

The safety from fire secured by the introduction of steam heating on passenger trains was well illustrated at Churchville the other night. The baggage car of the wrecked train turned completely over, and the baggage-master and a trainman were pinned down by trunks and were obliged to remain where they were for an hour. Had there been a stove in the car a disastrous fire could hardly have been prevented, and the two men would probably have been roasted to death.—*Rochester Herald.*

Superintendent of Motive Power Wilson, of the Chicago & Alton, has lately built at the company's shops at Bloomington, a new standard mogul locomotive for heavy fast passenger service. The cylinders are 18 × 24 inches and the drivers 64 inches diameter and the pony truck wheels are steel tired 28 inches diameter. The boiler is 54 inches diameter at the smallest ring, and has 218 flues 2 inches diameter and 13 feet 5 inches long. The fire-box, which has the foundation ring above the frame, is 90 inches long and 42⅝ inches wide. Tho total heating surface is 1,635 square feet. The engine has a straight stack and the Wilson spark arrester, and is equipped with all modern improvements calculated to promote the convenience and efficiency of the machine.

The Baltimore & Ohio Railroad Company have found the American continuous draw bar of so much advantage in saving cars from damage by the shocks of hard service that they have decided to apply it to all new freight cars. A lot of 200 new gondola cars recently built at the company's shops in South Baltimore have all been equipped with this useful safeguard of draft rigging.

A standard box-car belonging to the Cincinnati, Indianapolis, St. Louis & Chicago is 36 feet long, and is built to carry 60,000 pounds. The cars are provided with four small doors about midway between the ends and the large door for the purpose of facilitating the loading of grain, coke and coal at elevators and chutes. The cars are also lined from floor to plates with hard wood. Those using the cars are reported as testifying very highly about the increased convenience that the new arrangement of doors gives.

In referring to the new railroad just opened in China, the only one as yet in that country, a correspondent of the London *Standard* pays a very handsome compliment to American engineering skill. After remarking that the road in question is 86½ miles in length, and connects Tientsin, Taku and Tongshau, he continued after this manner: "There are many other splendid bridges amongst the fifty along the line, one especially, at a place called Chung-hang-Chang, built in America, and forming a very handsome, light, though strong, structure, with a span of 40 yards, which can be widened by a peculiar arrangement to admit a double line when it becomes necessary The line, it should be here mentioned, is for the greater part a single one, worked on the American 'bogie' system with loops at the stations."

The first electric crane ever built in the United States has just been introduced in the foundry of E. P. Allis & Co., of Milwaukee. It is a ponderous affair, weighing 30 tons, and is capable of lifting and carrying to any part of the foundry, with ease, a weight of 25 tons. The crane is of the usual traveling girder type, suspended on tracks built on each side of the foundry, near the ceiling. It is provided with three electric motors. One moves the crane from one end of the foundry to the other, another moves the carriage with which the crane in provided from one side of the foundry to the other, and the other runs the lifting machinery. Its advantage over the ordinary power traveling crane, which it resembles somewhat, is a saving of power and the wear and tear of machinery. The only other electric crane known is said to be in an English foundry, the latter being supplied with only one motor, rendering clutches and complicated gearing necessary.—*Engineering News.*

The water used for feeding the boilers of locomotives on most Southern railroads is so free from mineral impurities that the fire-boxes and tubes last nearly as long as a boiler, and consequently boiler repairs is a very light item of expense. On some portions of the country traversed by the Central Railroad of Georgia, the cutting down of forests is making surface water so scarce that the company have to sink artesian wells to obtain the necessary supply of water for the tanks. This is giving the mechanical department new and very undesirable experience. The deep well water is charged with lime and magnesia that deposit scale and mud with most deleterious results on the heating surfaces. They are using the Pittsburgh boiler scale resolvent with good success in neutralizing the destructive tendency of the feed water impurities, but the men in charge express a great deal of impatience and annoyance that doctoring of the feed water should be necessary.

Notes from a Locomotive Fireman.

A highly intelligent locomotive fireman writes us: I have read your article on Combustion in Locomotive Fire-boxes in the NATIONAL CAR AND LOCOMOTIVE BUILDER, and it appears to me that with a close study of the article and a little experiment out on the road, one would get equal to the emergency like that overcome by Engineer Thomas. The incident carries my mind back to think of a fire-door used by Mr. Stroudley, of the London, Brighton & South Coast, which acted in a way similar to a scoop reversed and held in at the door opening. The air was admitted through small holes in door shell, which, striking a scoop-shaped lining, was propelled on top of the fire.

In my firing practice I have frequently been troubled by too much air being drawn through the grates carrying the fine particles of coal up against the flue sheet and through the flues, causing spark throwing. This I could sometimes remedy a little by closing one of the dampers. We often have engines turn their fires upside down on a hard pull from the same cause, I think, and had to shake coal through until we got the live coal down on grates again, which was a waste of fuel. This is done very often. Now, if we had something after the manner of this deflector to draw and throw the air on top and to get it to burn down to grate bars again it would be a help to us.

A rather curious incident occurred on the Chesapeake & Ohio a week or two ago. A tank of vitriol or acid on a freight train got to leaking on the rails. It was some time before engineers could make out what freak possessed their engines, causing them to slip until they stood still, and, in some cases, having to double hills. Passenger engines would not stop at their accustomed places at stations, and it was looked upon as rather odd until the cause was discovered. It being night made it worse.

Electric Street Cars.

The most objectionable and most expensive method of operating street railroads is by horse-power, and the prolonged survival of this barbarous means of propulsion has been due in a great measure to the want of a satisfactory substitute. It looked for several years as if the cable system was destined to supply the most efficient and economical means of transmiting power for the propulsion of street cars, but lately various electrical appliances have proved so much superior to the cable as a substitute for horses that the indications now are that electricity is the coming medium through steam engines will operate street cars. There are few large cities that have not one or more lines of street railways operated by electricity, and the number of companies that are substituting this form of traction in place of horse-power is very large. At present electricity is conveyed to the motor which drives the car principally by conductors leading from a central station where the electricity is generated, but the experience with storage batteries indicates that the practicability of each car carrying its own power in storage cells is very promising.

The aldermen and other officials comprising the municipal government of cities are not displaying much disposition to encourage the development of electrical methods of operating street railways, and many of them offer very active opposition. The opposition to this line of improvement is decidedly discreditable to all concerned, for the change from horse to electrical traction is a benefit to the community in several ways. It increases the cleanliness of the streets, and makes them much easier maintained in good order, and it greatly decreases the noise of operating. Cars operated by electricity are much more comfortable to ride in than those pulled by horses or cables, for there is none of the jerking in starting which characterize the latter means of applying power.

Building Railway Rolling Stock in New South Wales.

A lively conflict has been raging in New South Wales for several years, which ought to be of interest to a good many of our readers. One party in the colony has been striving to build up native industries, and as an outgrowth of this policy agitations have been carried on favoring the building at home of part of the rolling stock used on the railways which are operated by the government. The other party is for free trade, with strong leanings towards all purchases of railway material being made in Great Britain. The London engineering journals took a particularly strong partisan stand in the controversies that arose between the two parties, and every one favoring the policy that was calculated to take away some business from British workshops was vigorously abused, the engineers who were in favor of doing the work at home being the main victims of abuse and contumely. The arch-traitor, as portrayed by the British writers, was Mr. Thomas Midelton, who was for a time the head of the railway mechanical departments. While holding that position some five or six years ago, Mr. Midelton became convinced that the American locomotives in use on the railways of the colony were better suited for the work than the engines of English design, and he had the courage to state his honest convictions. That has not been the fashion in the Australian colonies. The American type of locomotive is pushing its way to the front in all the colonies; but the practice is to imitate the American design and have the locomotives made in some British shop and call them the Burnett type or some other such name, after the man who appropriated the American makers' ideas.

The free trade party got on top and the men who favored building locomotives in New South Wales went to the bottom. Civil service reform does not appear to thrive out there. Again there was another turn in the whirligig of politics, and the home industrians were triumphant. The batteries of London opened again on the "ruinous" policy of building locomotives outside of the British Isles, but the noise did not frighten the colonists much, for they have put in Mr. Midelton for the second time as head of the mechanical departments, and under his supervision, and after his plans, the government is building 25 moguls and 25 consolidation locomotives. A proposal made by Mr. Midelton to use steel fire-boxes instead of copper has brought down upon his head a storm of ridicule and a host of opposition. They say that nothing can be successfully used for fire-boxes except copper. According to this view of the case, the thirty thousand locomotives in America that are struggling along with steel fire-boxes are each and every one a monument of failure. This will certainly be good news to the copper monopoly.

Richmond & Danville Railroad Shops.

Editorial Correspondence.

Across the James River from Richmond is the town of Manchester, interesting to railroad men as being the burg where the shops of the Richmond & Danville system are located. Probably the same shops impart any claim for note that the place possesses, as they certainly contribute very materially to its prosperity.

WELL STRETCHED CAPACITY.

A man going round the country looking for ideal railroad shops might not consider those at Manchester as being worthy of exact imitation, but nevertheless he would find a good many things that would excite his admiration even if he had made the rounds of all the best shops to be found. The Richmond & Danville shops have the best manufacturing facilities of any establishment of the kind I have seen in the South, and there are few so well-managed shops to be found anywhere. The shops were originally built to do the work for the rolling stock of 140 miles of road, and they were considered sufficient to meet the business that would develop from the growth of a few years; but the designers would not have expected that they would ever be called upon to take care of the machinery that they now keep in good order. These shops form the manufacturing headquarters for the rolling stock and a great deal of other machinery and supplies required for 2,383 miles of railroad. In the equipment to be maintained there are 277 locomotives and close on 6,000 cars. The working plant is spread over a vast territory, much of it on small branches with inferior roadbed which makes the call for repairs high. With all these disadvantages, and shops that have been increased by inconvenient additions, the machinery is kept in excellent order, and the work is done at moderately small expense.

FOREMEN WHO GET CREDIT FOR THE WORK DONE.

The place was originally organized by Captain Wade, superintendent motive power of the system; but it is now in charge of his chief lieutenant, Mr. T. W. Gentry, who deserves great credit for the way the work is carried on. Mr. Gentry is an exceptionally able executive mechanical officer, and he is helped by a very fine class of foremen who receive credit from their chief for any special merits they display. As I accompanied Mr. Gentry round the shops, he frequently directed my attention to special methods of doing work, and always gave credit to the foreman or workman who originated it. That is a manly way of treating assistants, and is in pleasant contrast to what one so often finds, where the head of the shop or department acts as if it would ruin his own reputation to give a little credit to the men who carry on the details of the work. One thing I notice is, that the men who habitually ignore their assistants have not much reputation to lose. The men who have been most successful in all departments of railroad life were those who surrounded themselves with able assistants, and able assistants cannot be retained or hired unless a man has the reputation of treating them well.

GENERAL SHOP FACILITIES.

There are lines of piping that convey compressed air to all parts throughout the system of shops, and this is used for a great many purposes that facilitate work. In connection with gas or charcoal, the compressed air blast is utilized for heating frames and other heavy forgings that have to be straightened or bent, and it often saves the taking apart of machinery. The air is also used for testing valves and air apparatus, for connecting with blowers to blow the fires of engines where steam is wanted quickly, for putting pressure on oil tanks to force the oil out somewhat after the fashion that water is forced out of the tanks in sleeping cars, and for a great many other useful purposes. They have an excellent system of water supply for fire purposes. A constant pressure is maintained in the pipes by large Cameron pumps, which is the standard pump used all over the system, and in addition they have a tank elevated 96 feet, which holds 36,000 gallons of water. An electric device, invented and put up by Mr. J. M. Holt, foreman of car repairs, informs the engineer in the engine-room when the tank is full, and it also gives notice when the water falls a certain distance in the tank. In addition to these mechanical precautions against fire, they have a well organized system of fire companies, that will make prompt and intelligent use of the appliances in case the necessity arises.

RUNNING A CORLISS ENGINE WITH ONE END OF CYLINDER.

The shops are run by a Corliss engine, which once was made to do a very unusual thing. Just after the molders had begun to run off a heat from one of the cupolas, one of the valve rod-pins of the engine broke and the engine was stopped. There appeared to be a strong probability of the iron in the cupola becoming cooled, when Mr. Gentry hurried round to the engine and disconnected the valve gear at the end of the cylinder where the rod was broken. He then put men pulling on the fly-wheel and started the engine, with steam working on one end of the cylinder, and kept the machinery going in that way till the heat was run off. This is the first case we have on record of a Corliss engine running with steam applied to one end of the cylinder.

WORK IN THE CAR SHOPS.

They have a small but very busy planing mill, which is well supplied with the best wood-working machinery. The foreman of car building, Mr. John B. Vaughan, deserves credit for the clean and orderly condition of this shop. The lumber follows a zigzag course in passing through the mill; but it is not subject to any unnecessary delay. From the planing machine a stick has to go back to the cutting off machine, then it is slipped aside to the tenoning machine and from that onward to the borer. All lumber goes out from the planing mill finished to templates, and all that the erecting gangs have to do is put the parts together. Car building is done as systematically and expeditiously here as it is done in any rail road shop I have examined.

FINE LUMBER.

Few shops have such a fine selection of lumber to work on. Nearly all the lumber used is cut in the country traversed by the company's lines. The finest selections of yellow pine that I had ever seen in connection with a railroad shop was here. And their supply of different varieties of poplar, oak, ash, cherry, maple and other woods used in railroad work was interesting to examine. There were boards of yellow poplar 28 inches wide and 20 feet long that had not a check or knot on the whole surface. They are using this wood for the outside of passenger cars, and they are getting it so cheap that they intend using it for the siding of freight cars. They use the Curran lumber dryer, and speak very highly about its efficiency. A considerable portion of the lumber used is kiln dried, but they keep a large stock on hand which enables them to use more nature dried lumber than most roads or central shops.

NEW CARS.

They were building some new express cars with sills and frames of yellow pine, and the end sills of oak. The inside and outside sheeting is of poplar. The inside is finished in selected cherry, and it looks about as well as mahogany, and is readily mistaken for that beautiful wood.

All the passenger cars have the Master Car-Builders' standard box and pedestals; they are all equipped with the Westinghouse quick action valve and air train signal. Several trains are heated by the Martin steam system. There is often an undue amount of work expended in getting the ends of equalizers to fit the rounded top of the M. C. B. standard oil-box. Here they attach a connection to the table of the slotting machine that rotates the table and makes the tool cut the bearing surface to the required radius. It is a neat arrangement, and saves a great deal of labor.

All new freight box cars are built thirty-four feet long, and are equipped with M. C. B. coupler and air brakes. All the iron work for cars is made to templates, and the same pieces are used below the body for all classes of cars.

PREVENTING THE SLIDING OF WHEELS.

A switch engine equipped with air brake and air signal attachments is used for making up passenger trains, and it charges the train with air, and tests the brakes and signal before the train engine is put on. As the brake-governor is used on all engines, and as they are very particular to have uniform pressure maintained, the train engine causes no delay in releasing the brakes before starting, although another engine supplied the pressure to the auxiliary reservoirs. They devote great attention to the proper adjustment of brake leverages, and find it pays in the saving of damaged wheels. They are applying the Hodge system of leverage on all passenger cars, and the levers are plainly marked, so that any car inspector can readily make the required adjustment.

MACHINE SHOP.

So far as conveniences due to the original design are concerned, the locomotive department is behind that devoted to car work; but they have a machine shop well filled with good tools, a tool room furnished with first-class small tools, and foremen watching to make the best of their facilities. Mr. W. H. Owens, the general foreman, is a progressive man who is constantly watching for improvements in machinery and in the methods of doing work, and the shops bear material testimony to this tendency.

A line of small shafting traverses the shop, and by means of rope belting it transmits power for the operating of drills, taps, steam-chest planers, boring mills, etc. On the head of their boring mill they secure three cutting tools set one behind the other. They bore all sorts of cylindrical surfaces with this tool, many jobs in fact that are done on the lathe in other shops. They bore the engine cylinders in the large wheel lathes when it can be spared for that purpose.

USING DUPLICATE DRIVING WHEELS.

They have only six pits for doing all the work that has to be turned out; but they make the best of the accommodation by using duplicate parts that are ready for applying when an engine is taken in. When an engine comes in to get driving wheels turned up the wheels with the worn tires are removed and others put under the engine, and she is ready for the road by the time the worn tires are in the lathe. They have been following the very wise plan of putting larger boilers on old engines, and they now have some of the most economical engines that are to be found working on this continent. One engine running an express passenger train has been for months pulling five cars with a coal consumption of 70 miles to the ton, equal to 30 pounds to the mile. If any other engine is pulling a train of five cars on as small a fuel consumption I should like to hear about it.

IN THE TOOL ROOM.

The tool room is run on the most advanced system, all tools being sent out and charged by checks. All drills are ground in the tool room, and no workman who uses tools or drills is permitted to change them in any way. They have reamers tapered in series, and a very fine set of shell reamers that fit expanding mandrels. The supply of templates, gauges, and small tools for special operations is unusually good, and they are all kept in excellent order, a condition by no means so common as it ought to be.

There is a very progressively run blacksmith shop where numerous formers and mechanical contrivances for aiding the production of work are in use. They have an arrangement of angle blocks that bend diamond truck bars to the required shape. The combination can be set for different patterns. Clamps for draw-gear and other articles are bent to the required shape in the same way.

The foundry turns out as fine castings as are to be found anywhere, and there are very few establishments that produce such fine cylinder castings. They are made from a mixture of Virginia pig and Ramapo wheels. The patterns are kept in a well arranged storehouse, every piece being registered and indexed.

The brass foundry was found to be too small for the business to be done, and Mr. Gentry doubled its capacity by putting in the chimney a blower operated by the exhaust steam from the stationary engine.

WORTHY OF MENTION.

Among things worth mentioning, they use a cast-iron smoke-stack for all locomotives. It looks very well; is light, very durable and costs, ready to put on, $11.40. They put a lining of block tin on their cross-heads instead of gibs, and speak very highly of the durability and smooth running features of the plan. The steam branch pipe in the smoke-box is cast in one piece—that is, the side pipes are cast in one piece with the nigger-head. They use U. S. metallic packing for all glands, and have special jigs for making it in. They find this packing much more economical than fibrous material. Single nozzles are used on a great many of the engines, and the 20 by 24 consolidations use that kind, 5¼ diameter. They keep their engines wiped clean, and their freight engines especially are a pleasant contrast to the monuments of grease that do duty for locomotives on some roads where strangers may readily believe that the companies have set overgrown dirt carts to pulling their freight trains.

The foremen whose names I have not already mentioned are: Mr. J. W. Alexander, of the blacksmith shop; Mr. T. J. Woodall, of the foundry; Mr. W. T. Ledford, of the paint shop; Mr. W. T. Davidson, of the car shops; Mr. J. J. Bayley, of the machine shop; and Mr. Albert Witte, of the planing mill.

A. S.

Inspector of Station and Train Service.

The Wabash Railway management have appointed an officer with the title of "inspector of station and train service." The duties of this new officer are thus explained in a circular announcing his appointment:

"The duties of this official, who is not clothed with authority in matters of discipline, are to go among the agents, operators and train men on the road, questioning each man or crew as to how they understand the rules, and observing how they are carried out; to answer all questions propounded regarding the proper construction of each rule, and in every way to aid the men to become more efficient employés, and the management to render the public first-class service. It should be understood by all employés in the transportation department that this official shall be respected in the same manner as the train-master or any other officer, and that he is only expected to report violations of the rules to the same extent as every other employé is required to do, and by proper warnings keep the men out trouble if possible."

We judge from the words of the circular that the inspector of station and train service will perform towards station agents, conductors and brakemen duties similar to those performed towards engineers and firemen by the traveling engineer. On roads where intelligent care has been exercised in selecting the traveling engineers, they have been the means of effecting material saving in the operating of motive power, besides securing safer and more regular service. There is no reason why the work of the inspector of station and train service should not be productive of equally good results.

The Canadian Locomotive and Engine Company have received a contract to build three large power pumps for the Ottawa Water-Works. They are also working on compounding the engines of two steamers, and other marine work, in addition to their regular business of locomotive building, which is unusually active.

Tender Trucks of Locomotives.

At the February meeting of the Western Railway Club, Mr. John Hickey, general master mechanic of the Milwaukee, Lake Shore & Western, read the following paper:

Once more we resume consideration of a subject pertinent to our business cares and quite important to the interests which we represent. The well developed locomotive of to-day merits a place of great honor among the machines of the world. Competition in their manufacture, coupled with great freedom of discussion of the relative merits of material that go to make up the parts, the relative proportion of parts, and the designing of these parts, that will be most effective in performing not alone its own duty, but have the qualification of rendering to its neighbor in the combination the greatest amount of assistance, are elements that have led to rapid improvements in the locomotive. The freedom of discussion and the interchange of views between railway men have brought about a great change in railway mechanics, and have supplied and brought to light many points long in the dark. To the influence of mechanical club meetings is due much credit for the usefulness, the beauty, and the symmetrical appearance of the modern locomotive.

There is not a point between the rear of the deck plate and the nose of the pilot, or from the rail on which she rolls to the whistle top, the merits or demerits of which have not more than once formed a subject for discussion. But what of the tender? Discussion of its parts has been few and far between. Its history is unwritten save its record in the book of hot boxes and flange-worn wheels.

Our ideas in a great majority of cases have stepped from the locomotive to the car, and from the car to the locomotive, giving little, if any, consideration to the important vehicle that forms the communication between both. My object at this time is not to deal with the construction of frame or capacity of water tank of the tender, the trucks on which it is carried being the subject under consideration, but it is a well known fact that we cannot deal intelligently with the foundation without being somewhat informed of the weight of the superstructure. One of the definitions of the word tender given by Webster is a small vessel employed to attend a larger one for supplying her with stores or other supplies. If this had reference to railway tenders, the size of many recently constructed would point to the belief that the words quoted in the definition should be reversed, and instead should read, a larger vessel employed for supplying stores and other supplies to a smaller one. Many tenders lately built have a coal space capable of receiving seven tons, and a tank capacity approaching 3,800 gallons. Here is a combined weight of coal and water of over 45,600 lbs. The weight of a tank and tender frame capable of sustaining this load will not be less than 17,900 lbs., which, plus 45,600 lbs., equals 63,500 lbs. To carry this load a pair of trucks built of the ordinary pattern will weigh not less than 12,000 lbs., which amount added to 63,500 lbs., gives a total weight of tender when loaded, including trucks, of 75,500 lbs. Deducting from the last named figures the weight of eight wheels and four axles, which approximately will weigh 6,400 lbs., we have left a weight of 69,100 lbs. for which we must provide wheels and axles. Assuming we have trucks of eight wheels, each wheel must bear a load of 8,637 lbs., and if we use M. C. B. axles with 26¼ square inch journal bearing, we will get about 329 lbs. weight per square inch of bearing surface. With ordinary lubricants I have several times experienced difficulty with bearings running hot when the weight exceeded 300 lbs. per square inch of contact, and in order to reduce the weight per square inch of bearing, in this case we have but to increase the diameter of the journal from 3¾ to 4 in., which will give a pressure of about 300 lbs. per sq. in. When the weight per wheel is above 7,800 lbs. and not exceeding 8,800 lbs., axles having dimensions of the M. C. B. standard in all except an increase in the diameter of the journal to four inches will render very satisfactory service. This change can be made without disturbing the dimensions of the oil-box, brass or other attachments, and as it adds to the serviceable period of the axle, it would seem to be a desirable change, even under the lightest conditions of load mentioned above. Much less trouble from heating of journals will be experienced if, in reaching dimensions, those dimensions are not based solely on their resistance to fracture under the meditated load, but they should be made so large that the pressure they must bear will be distributed over so much surface that the pressure per square inch of bearing will not exceed the figures above given, thus making good lubrication much less difficult.

Journal bearings containing a composition of 6½ lbs. of copper to one of tin and well fitted to journals have given excellent satisfaction in tender trucks. Of course the success or failure of running a truck journal depends largely on the character of its oil box; the latter should have ample space for oil and waste, and be provided with well fitting lids to prevent the entrance of dust at that point, and should by all means be supplied with large, well fitting and elastic dust guards at the back, for the double purpose of preventing a loss of oil and excluding dust from the boxes. A lack of appreciation of these facts causes annoyance and delay to the trains and much vexation from hot boxes, and any increased cost caused by giving the matter strict attention, will be amply justified by the reduction in the cost of lubricants alone.

The character of wheels best suited to tender service depends on the weight per wheel and speed required. For fast passenger service a steel tired wheel about 36 inches in diameter is without doubt the most desirable, in that it is, perhaps, the safest, but for a load per wheel up to 9,000 pounds, and with moderate speed, a good cast wheel 33 inches in diameter, having the metal so placed in its formation that its strength at all parts will be proportionate to the strains it is intended to bear, will do nicely.

Much is said and written about its treatment in casting, and the quality of material used in cast-iron wheels, and as both elements are of vital importance to the character of the wheel, agitation of the parts is highly important, but next to having a good quality of metal, the necessary amount and a proper distribution of it are the most essential elements. If it is practically determined that a wheel is weak at a certain point, it should be strengthened at such point by an increase of metal, and so on at other points, until it has assumed proportions capable of withstanding not alone the strains and shocks that are brought to bear upon it, but have left a reasonable margin of safety. Limiting the weight of a wheel without taking other matters into account is limiting its strength, and I venture to say that as many failures of cast iron wheels are due to scarcity and improper distribution of the metal they contain, as from any other cause. Wheels 33 inches in diameter, weighing about 550 pounds, have for years given fair satisfaction under a load per wheel not exceeding 7,000 pounds. We have increased the load to 9,000 pounds per wheel, and to meet this increased load we have added barely 50 pounds to the weight of wheel; in other words, we have increased the load about 33 per cent., while the wheel to bear the load (that from the first had no greater margin of safety than was necessary) has been increased in weight but an amount less than 10 per cent.

I have always believed that the running gear of railway rolling stock should be constructed of such strength and with such intelligence as to give it a high factor of safety. The better this part of the machine is constructed the cheaper it will be in the end. I have felt especially that if any good work is necessary anywhere it is in the running gear; if the element of cheapness must enter its construction, let it be placed at some other point. The demon of cheapness has interfered with progress in this direction until it has become a disgrace that almost amounts to criminality. It has been proven over and over again that well constructed running gear for railway vehicles is a positive saving of time and money; so that placing the question upon a money basis solely, it is largely to the interests of railroads to give this matter their closest attention. A device to whose keeping human lives are intrusted cannot be pardoned for failures to perform its whole duty when the predominant cause is shown to be cheapness in construction.

A tender truck should have constitutional qualities as perfect as that used to carry the front of a locomotive, and should have vertical and lateral bracings that would at all times insure a square and plumb position of the frame and its attachments. To its frame should be attached suitable pedestals forming jaws, the centers of which should be equal distances from the center of bearing, these jaws to enter corresponding ways on the oil boxes, for the purpose of permitting a vertical movement of the parts. The truck body should rest on springs, which in turn should bear on equalizers introduced for the purpose of conducting equal strains to the journal bearings. Its parts should be planed to fit and reamed holes and turned bolts should enter its construction. The truck bolster at center should have sufficient stiffness to bear with ease the maximum strains brought to bear upon it by the tender and its load. From my observation and experience with many trucks of different design, I should advocate center bearing and rigid bolster for all with side bearings only for the purpose of meeting any undue lateral rolling action of the tender body.

All roads should seek to establish a uniform and interchangeable tender truck, and this with having both trucks of the same tender alike and interchangeable will be found of greater advantage than the much advocated policy of interchange with car trucks It is difficult to see why locomotive tenders should rest on their trucks in any manner different from other railway vehicles, yet how often we see the tenders of many beautiful and well proportioned locomotives carried on four side bearings resting on monuments of bar steel usually called springs. Such trucks have no central connection with the body other than a pin placed for the purpose of retaining body and trucks in central position. Were we to see a car body attached to, and moved on its trucks in this manner, we would entertain serious doubts about its passing safely over the first curve on its route, and readily condemn it as being unworthy of the mechanical skill of this age. The trucks of the tender, like the trucks of its honored partner, the locomotive, should possess the elements of scientific construction, simplicity and strength, and should be attached to the tender in a manner that will permit the truck the greatest freedom of action, particularly while passing through curves and turnouts; this can only be accomplished by properly constructed central bearing trucks, resulting in less cost for repairs, fewer hot boxes and less flange worn wheels. It will thus be elevated to a place in keeping with the modern locomotive whose appendage it is, a machine that has reached a point of perfection having no parallel among human inventions.

I had hoped to present for your criticism drawings of various styles of trucks, together with a sketch showing a design of tender truck in accord with modern ideas, but from a pressure of other duties I was unable to complete them.

Master Mechanics' Association Circulars.

The following circulars have been sent out by Secretary Sinclair, of the American Railway Master Mechanics' Association:

BEST PROPORTION OF FLUE AND GRATE AREA IN LOCOMOTIVES.

The following questions refer to boilers using bituminous coal:

1. Have you, in renewing boiler tube plates, or in building a series of new boilers, altered the number or size of flues, or altered the clearance space between them, without altering the length of flue or altering any other part of the boiler or engine?

If so, can you give comparative results, either in fuel consumed for work done or in water evaporated, stating the exact change or variation you made which produced such results? This information should be given in answering any of the questions, and in quoting results, endeavor to distinguish between higher evaporative power ("free steaming") and increased economy in evaporation (more water boiled off per lb. of fuel).

2. Have you made any such change keeping the flue-heating surface the same in total amount, but putting in flues of larger diameter, so as to increase the gas opening through the flues; or made any such change, still keeping the flue-heating surface the same, but putting in flues of smaller diameter, thus decreasing the gas opening through the flues?

3. Have you made any such changes, either shortening or lengthening the flues, but keeping the total flue-heating surface the same?

4. Do you know of any instance in which reducing the flue-heating surface, or reducing the gas opening through the flues, increased in any way the efficiency of the boiler?

5. Have you made any changes in the amount of grate surface without altering the boiler or engine at any other point? If so, with what result? If you have knowledge of any experiments of this kind carried out on other than locomotive boilers, kindly quote them also.

6. In designing or ordering locomotives, do you proportion the amount of grate surface simply to suit the quality of coal likely to be used, or do you believe—if the boiler is to be in its most effective condition—that the grate surface should bear some definite proportion to the flue heating surface, or to the gas opening through the flues? If you proportion, give the ratios you use or would like to use.

7. Is it possible, within the narrow limits of deviation allowed in an ordinary locomotive, to give a boiler too large a grate surface?

A grate may be too long for the fireman to equally cover it with coal, or it may have too much air opening through it to suit certain qualities of fuel; but these points are not properly to be taken into a consideration of the question of absolute grate surface.

8. If to use a certain quality of fuel you have found it necessary to put at one end of the grate a solid "dead plate" or "drop plate," has such reduction of the effective grate area lessened the evaporative power or the economical efficiency of the boiler? In answering question 8, a note should be made as to whether, in making the change, the clearance between the fire-bars (air space) was altered.

9. Have you in any way improved a boiler by reducing the total grate surface, all other points remaining unchanged?

10. Are you familiar with any experiments tending to show that rapid combustion is, for steam purposes, more economical than slow combustion? If so, quote or refer to them, and say if you think the result is due to higher temperature (commonly believed to accompany rapid combustion) transmitting a larger portion of its heat through the metal or to a more thorough burning of the fuel.

This matter has a close bearing on the whole subject, for, other things being equal, the smaller the grate the more rapid is the combustion.

11. What is the present limit, in locomotive practice, to the number of pounds of good clean coal that can be fully burnt per hour per square foot of grate surface?

12. Are there any facts from which it may be reasonably inferred that this limit will in the near future be exceeded?

13. How many pounds of water (from and at 212 degrees) will one pound of good coal evaporate when the grate is thus working up to its highest limit?

What is the minimum amount of flue surface per square foot of grate that will do this high duty?

J. DAVIS BARNETT,
F. W. DEAN,
PHILIP WALLIS.

Replies to be sent to J. Davis Barnett, Grand Trunk Railway, Stratford, Ont., Canada.

DRIVER-BRAKES, ETC.

1. How many locomotives of each class, viz., passenger, freight, and switching, are equipped with driver-brakes on the railroad with which you are connected?

2. Of the above, state in detail how many are operated by compressed air, by vacuum, and by steam. Which gives the best results, and why?

3. Give in detail the number of engines of each class equipped with each style of brake, viz., the *spread*, the *pull*, and the *clasp*. Which gives the best results, and why?

4. Are brake-shoes applied to *all* the driving wheels? If not, please say in what respect and to what extent deviation from this practice is followed, and if unsatisfactory wear of tires has resulted.

5. From your experience, under what circumstances do you recommend the use of the driver-brake in conjunction with train brake? Do you consider the driver brake should be used in making every stop, or for emergencies only?

6. Do you consider the braking of engine truck wheels to be of sufficient importance to warrant the additional cost of equipment and maintenance?

7. With what different brake-shoes have you had experience? Which do you recommend, and why? Please send drawing of same.

8. Please give results of experiments, if you have made any, showing the relative endurance of various kinds of brake-shoes, under similar conditions, also the effect of same on tires.

9. What ratio do you recommend between pressure of brake-shoe on tire and pressure of tire on rail?

10. What ratio do you recommend between pressure in pounds on each brake-shoe and the number of square inches of shoe in frictional contact with the tire?

11. How many engines of each class are there on your railroad equipped with the water brake?

12. What is average cost of necessary material and labor fitting up this brake? Please supply blue print showing general arrangement of same.

13. Under what circumstances do you recommend the use of this device.

14. Have any unsatisfactory effects upon machinery resulted from use of this brake? and, if so, how can they be obviated?

15. If you can give other information bearing on this subject, you are respectfully requested to give the benefit of same to the undersigned.

CHARLES BLACKWELL,
H. D. GORDON,
W. H. THOMAS.

Answers to circulars to be sent to Mr. Charles Blackwell, engineer of machinery, Central Georgia Railroad, Savannah, Ga.

BOILER COVERING—BEST METHOD AND MATERIAL TO PREVENT RADIATION OF HEAT.

1. What form of boiler covering do you consider best to use?

2. Give your reasons for the preference.

3. If you use asbestos or other composite covering, please say how it compares with wood in first cost and in cost of maintenance.

4. Do you find that composite covering causes corrosion of sheets or of jacketing?

5. Do you find that composite covering inconveniently interferes with the examination of boilers?

6. What is your manner of putting on composite covering?

7. Please give your estimate of the comparative value of wood and composite boiler covering as preventive of heat radiation.

8. Please give any other information you may have concerning different forms of boiler covering.

G. W. STEVENS,
JOHN MACKENZIE,
T. B. TWOMBLY,
Committee.

Send replies to G. W. Stevens, superintendent motive power Lake Shore & Michigan Southern Railway, Cleveland, O.

NEXT PLACE OF MEETING.

The Executive Committee have made arrangements to hold the next annual convention at Niagara Falls, beginning Tuesday June 18, with headquarters at the International Hotel. The terms of $3 per day have been secured for members and others.

The proprietor of the hotel mentioned has agreed to reserve one hundred rooms for the use of members. All who wish to secure rooms should apply to Mr. A. H. Gluck, Manager, International Hotel, Niagara Falls, N. Y. For the Executive Committee,

ANGUS SINCLAIR, Secretary.

Standard Axles for 60,000-Pound Car.

The Secretary of the Master Car Builders' Association has issued the following circular:

The Master Car Builders' Committee appointed at the annual convention, held at Alexandria Bay, June, 1888, to submit an axle for 60,000-pound cars, request the following information:

1. How many cars of 50,000-pound capacity have you in service?

2. How many of 60,000-pound capacity?

3. Give the dimension of the axles used under the above cars.

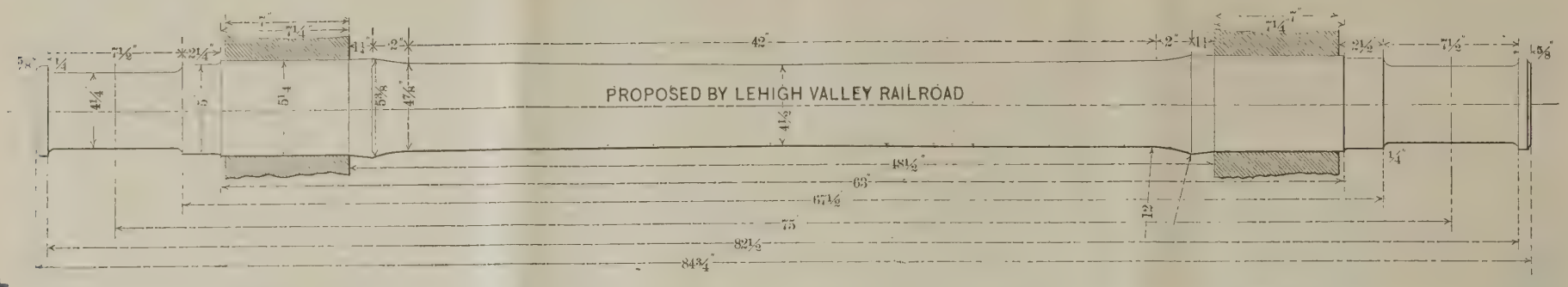
4. In case you contemplate any change in the above axles, give the dimensions you propose changing to, in red ink.

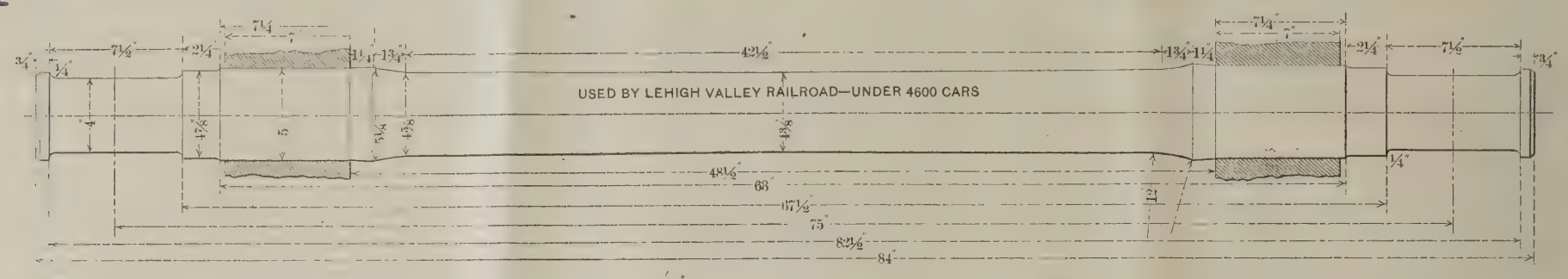
5. Should you have no cars in service of greater capacity than 40,000 pounds, give the dimensions you recommend for 50,000-pound and 60,000-pound, in red ink.

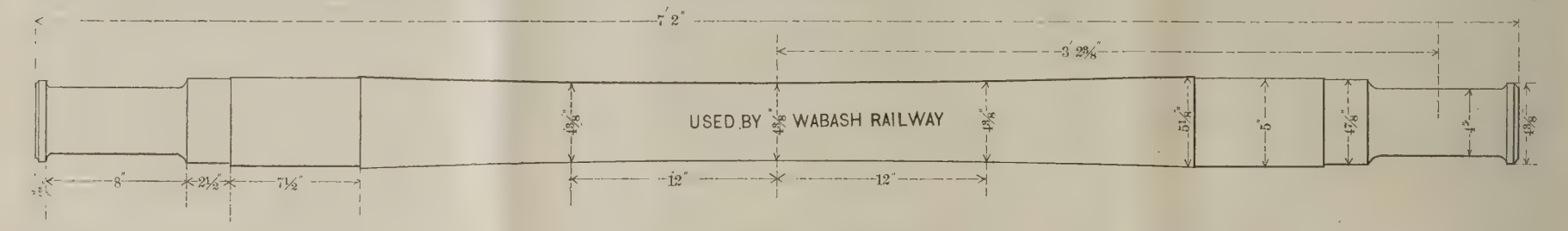
6. Replies to these questions should be forwarded to the Chairman of the Committee, at Aurora, Illinois, if possible, by March 15, 1889.

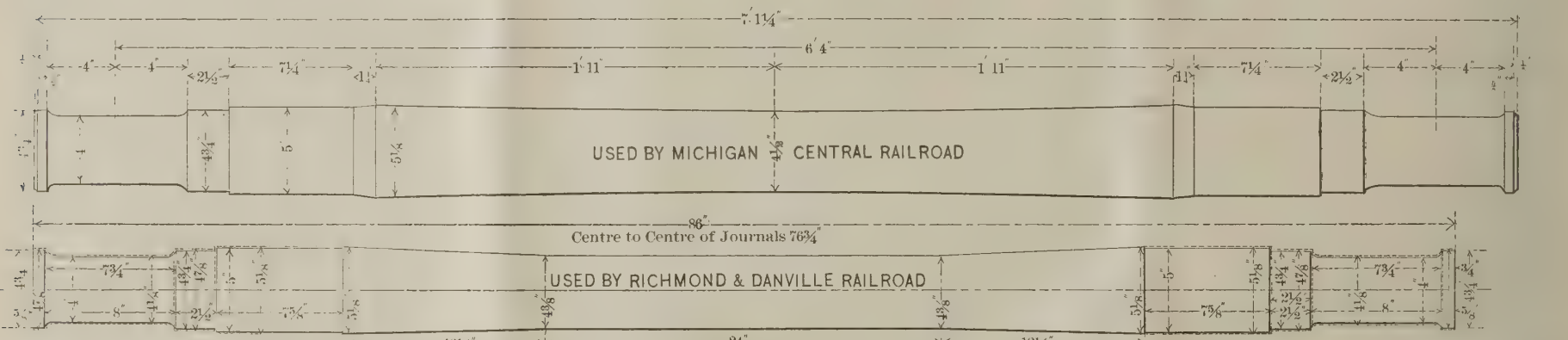
G. W. RHODES, *Chairman*,
JNO. S. LENTZ,
R. MCKENNA,
} Committee.

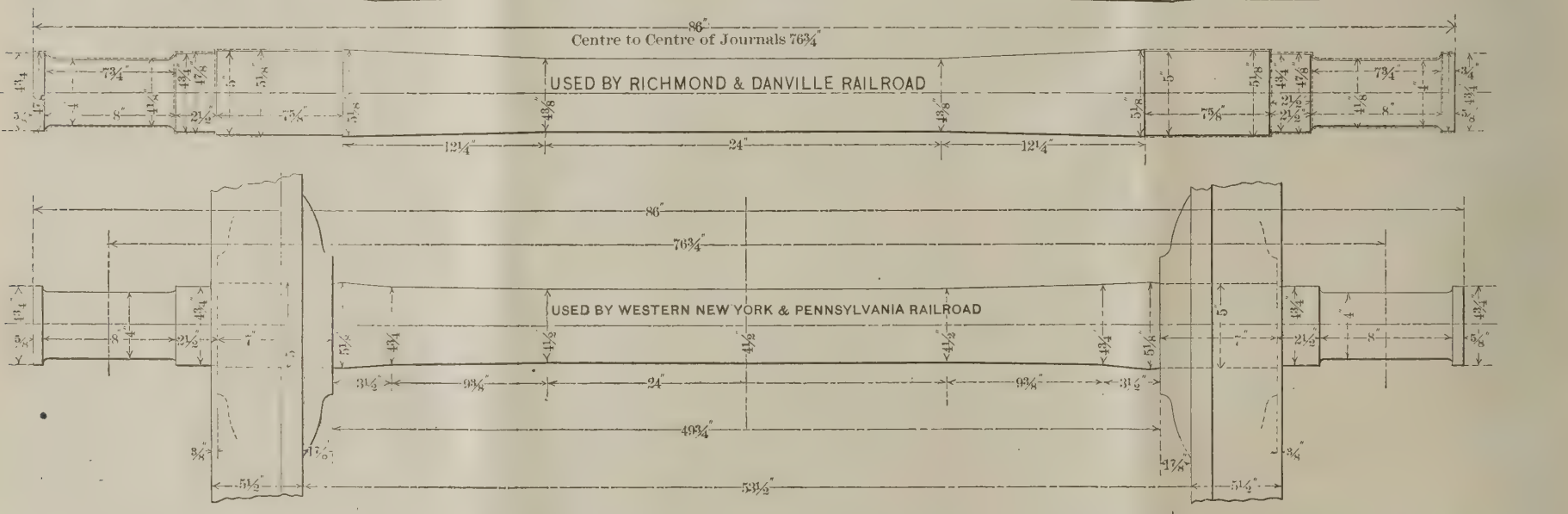
AXLES FOR HEAVY CARS.

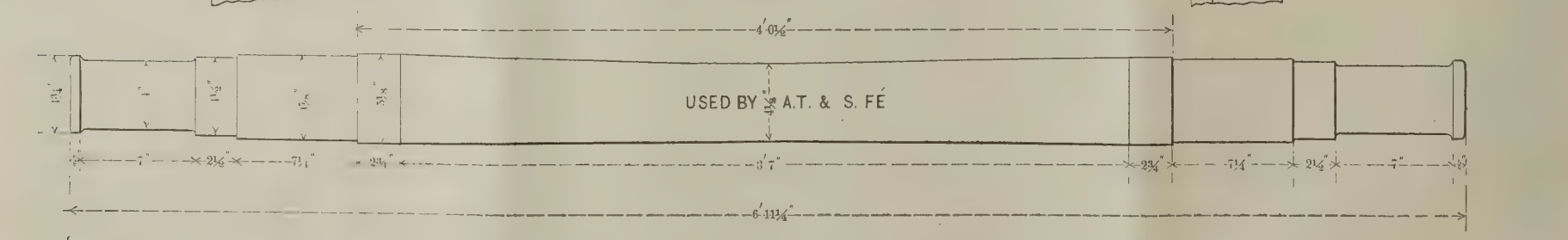


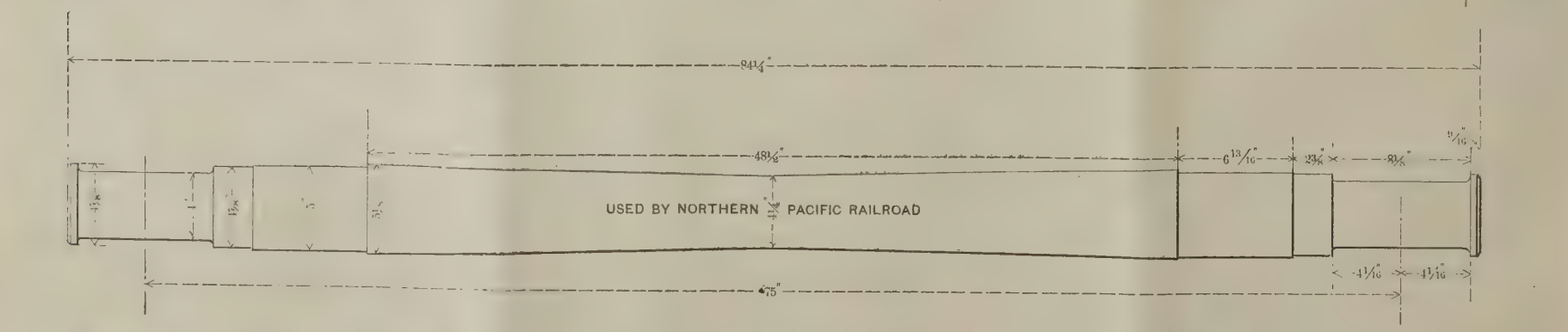


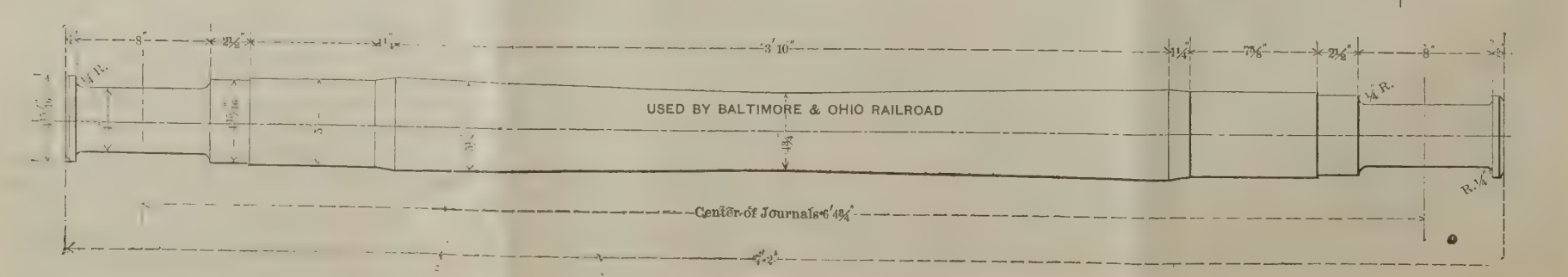












Axles in Use Under Heavy Freight Cars.

At the Master Car Builders' Convention held in Chicago in 1883, on motion Mr. H. Stanley Goodwin, a resolution was passed calling for the appointment of a committee of seven members representing the largest car owning roads, to confer together and agree if possible upon a standard house car with details of all parts, the maximum load to be 60,000 pounds. The committee was duly appointed and several reports submitted. No agreement was arrived at about the general construction of a house car to carry 60,000 pounds, but members of the Association were made familiar with the tendency towards much heavier car loads than had up to that time been considered practicable, and the necessity for designing an axle larger than the standard began to be recognized. Complaints had occasionally been heard before this time, that the standard axle was too weak for the load it was required to carry; but no movement in favor of adopting a larger axle was contemplated till Mr. Goodwin intimated by his motion that the demand for a car capable of carrying 60,000 pounds existed. After that the proper dimensions for an axle suitable for a 60,000-pound car became a common topic of discussion. In 1886 a committee was appointed to report on a standard freight car truck and axle for cars of 60,000 pounds capacity. The committee consisted of Messrs. M. M. Martin, R. C. Blackall, W. A. Scott, H. Roberts and Joseph Wood, all very able men, who appeared to give the subject under investigation earnest attention and patient consideration. They recommended an axle the dimensions of which are given in the annexed table. The axle recommended was sent to letter ballot and defeated by a small majority. When the matter came up for consideration in the convention at Alexandria Bay last year, a new committee was appointed to report to the meeting on the form of an axle that would be considered likely to meet the wishes of a sufficient number of members to carry it through the letter ballot. The committee recommended two forms of axles, one being collarless, the other of about the same general proportions but with a collar. When the report of the committee was submitted, very conflicting views were expressed by members as to the requirements of an axle to carry a 60,000-pound car, and after a lengthened discussion, the axle described in the annexed table was carried for submission to letter ballot. The decision was a compromise which appeared to suit no one particularly well, and the axle received very little support in the letter ballot, and the association is still without a standard axle for heavy cars.

It looks as if it were almost impossible for the master car builders and railroad companies to agree upon the proper form of axle required; but in the meantime we have found that railroads all over the country were building cars of 60,000 pounds capacity, and putting axles under them that are larger than the M. C. B. standard. In order to present information that would be useful in helping the M. C. B. Associatiation to select an axle at the next convention that a majority of car owners could agree upon, we wrote to all the principal railroad companies asking for particulars of the axle they are using for cars of 60,000 pounds capacity, and the engravings on these two pages and table annexed show the dimensions of most of the heavy axles in use. It will be seen that the axle submitted to letter ballot in 1887, slightly changed in some particulars, is used by the Wabash, the Western New York & Pennsylvania, the Pennsylvania, the Baltimore & Ohio, and the Richmond & Danville railroads The axle submitted in 1888 is used by the Chesapeake & Ohio only in all its leading details.

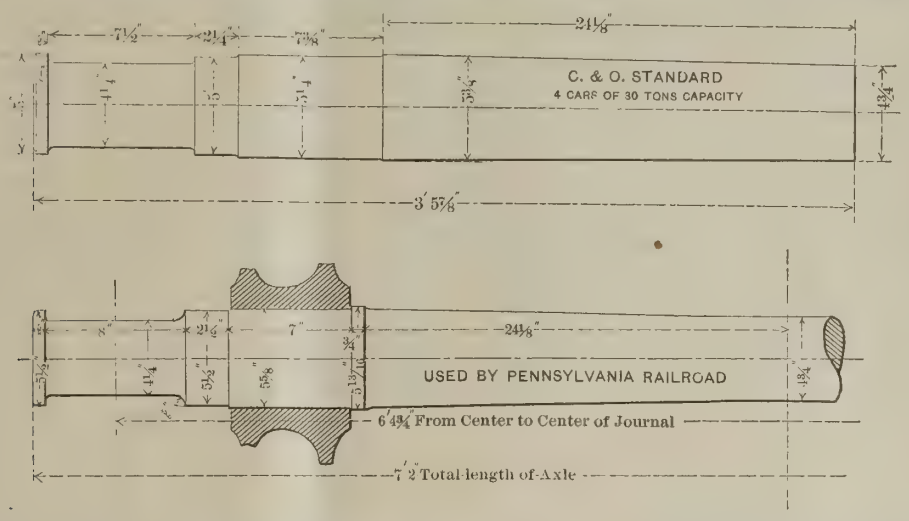
The following remarks were made by some of the railroad officers who wrote about axles:

Mr. H. Stanley Goodwin, Lehigh Valley, says: I send you herewith a blue print showing the form of axle which we are now using under our freight and coal cars of 60,000 pounds capacity. We have it now in use under 4,510 such cars and are putting it under 2,000 additional cars now in process of construction. We first commenced using this axle in the spring of 1885, and have used it continually since putting it under all our new cars of that capacity which we have built since that time. This axle has given us good satisfaction, but for standard we would recommend to make it a little heavier, as shown by the other drawing on the same blue print. You will observe that the distance from center to center of journal is the same on both these drawings, and that it agrees with the corresponding distance from center to center of the M. C. B. standard axle. There is a great advantage in this, because when these journals are worn down to such an extent that it would seem best to take them out from under cars of this great capacity, they can still be used under cars of lighter capacity on M. C. B. standard axles.

I inclose also a blue print showing the M. C. B. standard oil box and journal, and alongside it a longer and larger journal in the same oil box. You will see from these drawings that this large standard axle can be used in the way above named without changing the oil boxes under the cars which are now fitted with the M. C. B. standard. We are decidedly in favor of this construction for standard axle to be put under cars of 60,000 pounds capacity, and we think that this construction ought to commend itself generally.

Mr. W. T. Small, Northern Pacific, says: I send you herewith a blue print of the axle we use under the few thirty-ton capacity freight cars we have on this road. These cars were built for experiment by the Ohio Falls Car Company some three years or more ago, and were purchased by this road. The cars are giving us good service, but from our experience, should we build cars hereafter of this capacity, I should recommend a journal 4½ inches in diameter, and 7 inches long. I do not know any advantage in making a long journal, and I should also recommend the axle be increased in every part in proportion to the size of the journal as above.

Mr. L. B. Paxson, Philadelphia & Reading, says: The only 60,000-pound cars we have are those leased from the Iron Car Company of New York, hence have no standard 60,000-pound car-



axle as adopted by the Reading. We are building 50,000-pound cars, and are using the Master Car Builders' axle for them.

Mr. W. A. Foster, Fall Brook Coal Company, said they have no 60,000-pound cars of their own as yet, but he thought a car of that capacity could be safely carried on a M. C. B. axle increased in size, the wheel fit to be 5¼ inches, the center 4¾ inches and the journal 4¼ inches diameter.

Mr. Theodore N. Ely, Pennsylvania, writes:

We have not yet adopted this axle as standard, but will probably do so.

This axle is figured theoretically for its whole length, and we have increased the journal somewhat to compensate for wear and to give it a longer life.

Mr. Geo. W. Cushing, Union Pacific, writes: We do not have any such cars on this system, but I have studied this matter up considerable and see no reason why the axle, as per Fig. 3, shown in circular dated July 30, 1888, issued to the members of the M. C. B. Association with journal 4½ in. diameter by 7½ in. long, taking all the points connected with the subject into consideration, is not as good as can be got for the desired purposes.

The following are the dimensions of the principal axles in use for carrying cars of 60,000 pounds capacity.

	Total length of axle.		Center to center of journals.		Journals.	Dust Guard	Wheel Seat.	Center of Axle.
	ft.	in.	ft.	in.	in.	in.	in.	in.
Proposed by M. C. B. Assn., 1887	7	2	6	4¾	4 by 8	2½ by 4¾	5	4⅜
In use by Wabash	7	2	6	4¾	4 by 8	2½ by 4⅞	5	4⅜
" Western N. Y. & Penna	7	2	6	4¾	4 by 8	2½ by 4¾	5	4½
In use by Pennsylvania	7	2	6	4¾	4¼ by 8	2½ by 5½	5⅝	4¾
In use by Baltimore & Ohio	7	2	6	4¾	4 by 8	2½ by 4 13/16	5	4¾
In use by Richmond & Danville	7	2	6	4¾	4 by 7¾	2½ by 4⅞	5⅛	4⅜
Proposed by M. C. B. Assn., 1888	6	11¾	6	3	4¼ by 7½	2¼ by 5	5¼	4¾
Proposed by Lehigh Valley	7	0¾	6	3	4¼ by 7½	2¼ by 5	5¼	4½
In use by Lehigh Valley	7	0	6	3	4 by 7½	2¼ by 4⅞	5	4⅜
In use by Chesapeake & Ohio	6	11¾	6	3	4¼ by 7½	2¼ by 5	5¼	4¾
In use by Northern Pacific	7	0¼	6	3	4 by 8⅛	2⅝ by 4⅞	5	4¼
In use by Michigan Central	7	1¼	6	4	4 by 8	2½ by 4¾	5	4½
In use by Atch., Top. & Santa Fe	6	11¼	6	3	4 by 7	2½ by 4½	4⅞	4½
In use by Louisville & Nashville	7	0¼	6	3	4 by 8	2 by 4½	5	4½

Heating Cars Safely.

At the February meeting of the New York Railroad Club, Mr. W. C. Baker, president of the Baker Heater Company, read a paper, from which we cull the following extracts:

Artificial heat producers must be "as changeable as the weather," in order to meet the ever variating heating requirements of our climate.

A non-freezing hot water system is the only one adapted to the purpose, for the reasons that the heated water is the only medium that is susceptible of giving the varieties of temperature required to meet the ever-changing atmosphere, and there is no danger attending its use, as but one fire, and that a dull one surrounded by water, is required, even in the largest car.

The acceptable car heater must have its heat always ready, constant, of the right quantity and of an easily controlled kind, with heat evenly distributed among all the passengers as they sit in their seats, especially at their feet, while, at the same time, ample ventilation is assured.

The heat of a car must be constant. A cold car in cold weather will, or should, require at least five hours fireing to be comfortable.

Lastly, but most important of all, is that feature of the car-heater which directly relates to the safety of the passengers, their exemption from that most deplorable accompaniment to railroad disasters, death by burning, and to prevent this we most naturally and instinctively turn to the construction of a heater safe, similar to that in the express companies' car, which has proven by long service, and under the severest trials in car breaking, to be invulnerable.

Axle for 60,000-Pound Cars.

At the February meeting of the Western Railway Club Mr. G. W. Rhodes, Chicago, Burlington & Quincy, read a paper on the above subject, which is slightly abridged as follows:

At the annual convention held at Minneapolis in 1887 an axle of dimensions, as shown in Fig. 1, for cars of 60,000 pounds capacity was presented, and subsequently submitted to letter ballot vote. It will be noticed that the leading dimensions are: Journal, 4×8 inches; wheel fit, 5 inches; center of axle, 4⅜ inches. Distance from center to center of journals, 6 × 4¾ inches. The design was rejected by the following vote, a two-third vote being necessary for adoption:

In favor of	397
Against	253
Total votes cast	650

At the Alexandria Bay meeting of 1888 the design represented in Fig. 2 was, after a spirited and vigorous discussion, also voted to be submitted to ballot vote. A marked difference will be noticed in the diameter of this axle; the journal is 4¼ × 7½ inches, wheel seat 5¼ inches, center of axle 4¾ inches, and distance from center to center of journal 6 × 3 inches. This design has also been voted down.

In favor of	224
Against	307
Total votes cast	531

The discussion at the Alexandria Bay meeting disclosed a growing disposition towards the larger diameters represented in Fig. 2. Several of the members of our club who last winter questioned diameters as large as 4¼ for journals, 5½ inches for wheel fit and 4¾ inches for center of axle now advocate them. We are informed also since the Alexandria Bay Convention, several important lines not connected with the Western Club, and who heretofore have opposed diameters as great as shown in Fig. 2, have also changed their views, and that it is now entirely probable that in so far as diameters are concurred in we shall be able to come to an agreement at our next annual convention. In discussing the diameters of axles we frequently get into arguments over small figures; one will want a wheel fit 5¼ inches diameter, while another wants it 5⅜ inches, a second member will insist 4¾ inches is much too large for the center of the axle, and that 4⅝ inches is preferable. At the last annual convention, while such points were under consideration, an Eastern member, who has always been looked upon as one of the pioneers and pillars of the association, while advocating the larger diameters, said he was reminded of a precept or law our much respected secretary, Mr. M. N. Forney, is said to have received upon a certain occasion from his superior when he was an apprentice in the machine shops at Baltimore, viz., if you must make a thing strong, make it very strong. This is exactly what prudent and intelligent engineers and builders do. After figuring out carefully the greatest strains and stresses the structure under design will be subjected to, then they proceed to make it very strong, or, to express it a little differently, to allow what is termed a factor of safety over and above all calculated strains. In bridge construction the usual factor of safety over and above all calculated strains is between five and six, based on iron with an ultimate strength of from 48,000 to 54,000 pounds. The diameters of the axle for a 60,000-pound car represented in Fig. 2 give but a factor of safety of about 3½ based on iron, having an ultimate strength of 44,000 pounds, which is about what scrap-iron axles will average. It would appear then that our diameters are none too large, and that the more conservative of us need not have any scruples on the score that we may be getting an axle with more weight in it than is actually necessary; in other words, that we may be purchasing an axle which will cost more in dollars and cents than the service justifies. Where, then, you will ask, is the insurmountable difficulty now in adopting a standard axle for 60,000 pound cars? It is a matter of lengths, a question of 6 feet 3 inches, or 6 feet 4 inches, or 6 feet 4¾ inches, from center to center of journal. A subject not unlike the wheel gauge limit question, but, perhaps, more difficult to reconcile opposing views to, as it does not have the elasticity in dimensions of the wheel gauge.

Let us try, however, and view the question impartially from both standpoints. The dimension of 6 feet 3 inches from center to center of journal has been the Master Car Builders' standard since 1873, and subsequently was adopted by the Master Mechanics' Association.

Some of the members wish to change this with the 60,000 pounds axle to 6 feet 4¾ inches, as shown in Fig. 1, chiefly in order to secure a journal 8 inches long and at the same time retain the 2½ inch dust-guard. There can be no question as to the importance of ample journal surface. An advocate of the axle shown in Fig. 1 states that his experience is that the pressure per square inch of journal bearing should not greatly exceed 350 pounds. A prominent inventor some years ago, in advocating a large journal, stated that if adopted the pressure per square inch on the brasses would be reduced a sufficient amount to insure a much more perfect lubrication than railway people are now accustomed to where the journals are so small compared with the weight to be carried. The writer's views on this question were given with some tables and figures at our March meeting last year and need not here be repeated. Again, it is claimed that if the axle is made large enough in diameter at wheel seat and dust-guard to stand the strains which come upon it, that it will be found too large to enter the opening in the back of the Master Car-Builders' journal box; that while this might be overcome by turning the axle down where too large, that the correct proportions to meet the strains uniformly would then be destroyed and that the middle part of the axle would then be too large in proportion to the load, and the vibrations would be localized where the reduction had been made, making it liable to break at the reduced point. These arguments are deserving of full and careful consideration. One of the great Southern lines, anxious to retain the journal center distance of 6 feet 3 inches, and at the same time realizing the importance of a maximum bearing surface, has adopted for its heavy cars the design shown in Fig. 3. In Fig 4 this axle is shown in a Master Car-Builders' box; the full lines represent the old 3¾ × 7 journal and the dotted lines the 4 × 8 journal. With the latter it will be noticed the dust guard has been reduced from 2½ to 2 inches.

The majority of the advocates of 6 feet 3 inch journal centers feel that more economy will be realized in retaining these centers by the subsequent use that can be made of the axles, even at a sacrifice of journal length than otherwise. They lessen the pressure per square inch of bearing by increasing the journal diameter, and while recognizing the claim of greater liability to heat by the increased speed of the rubbing surfaces, cite the 5 inch diameters of engine truck journals on wheels of 30 inches and 28 inches diameter, as showing that the heat from this increase in speed of rubbing surface is taken care of by the additional metal in the journal for carrying the heat off. The strongest argument, however, is the subsequent use the axles may be put to, that is to say, the practicability of removing the axle from a 60,000 pound and transferring it to a 50,000 pound car, and from that to a 40,000 pound, and so on. Those advocating this method of treatment disclaim all belief in the crystallizing theory. They claim that when an axle can be transferred from one service to another, the temptation to run the journals to as small diameters as when condemning them from one particular service also means scrapping them is materially lessened, and in support of this cite the minimum diameters of the journals adopted by the rules of interchange, and which annually there is quite a contest to increase on the part of some railroads, and to keep small on the part of others.

A question which undoubtedly influences many in the consideration of this 60,000 pound car axle is whether it is really wise to consider it as limited to a car of that capacity? Is it not likely that we may have to provide for axles in the future for cars of 70,000 and 80,000 pounds capacity? It is the opinion of many that the increased pressure between wheel and rail will hardly per

(Continued on page 40.)

Railway Car Construction.

BY WILLIAM VOSS.

Sixth Paper.

STOCK CAR BODIES.

The name by which this class of cars is designated indicates the service they are intended for. In addition to this, they are utilized for the transportation of freight not liable to be damaged by partial exposure to the influence of the weather, such as lumber, coal and iron.

The general dimensions and capacity are about the same as those of the modern box-car; the clear width and

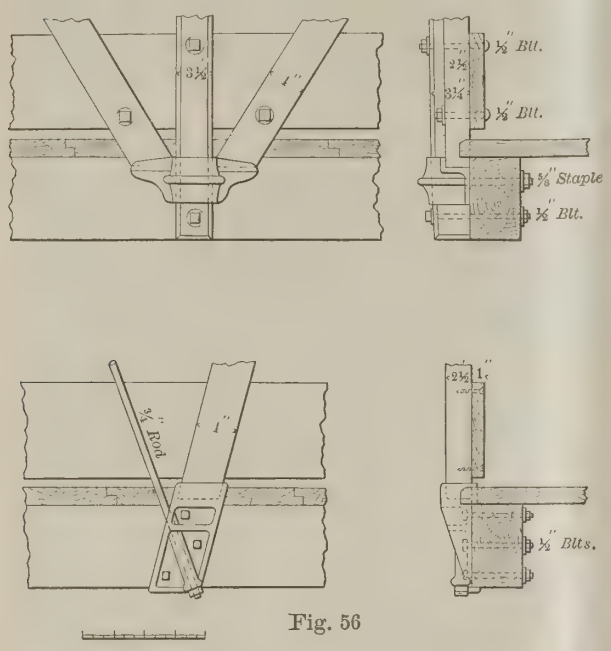


Fig. 56

heigth, however, must be sufficient to properly accommodate the stock in transit; the former should not be less than 8 feet 3 inches, and 8 feet 6 inches is by many thought necessary; the height between top of floor and bottom of carline should be about 7 feet.

The cattle car body differs from that of the box car principally in that the superstructure is not covered on the sides and ends other than by slats which freely admit the light and air, the floor and roof-frames being identical and the side and end frames varying but little. The latter were at first constructed with the posts resting in stake pockets, like those used on gondola cars, the practice being probably established from using an already existing flat car for the foundation and adding to this a temporary framework in much the same manner as the flat car is at the present time converted for the transportation of wagons, furniture and agricultural implements, or any goods requiring an unusual amount of space, and it is not desirable to build permanent structures for this purpose.

Fig. 56 shows the provisions usually made for the support of the braces at the transom and intermediate posts, unless they are placed on the inside of the slats and rest in sockets on the floor, as is sometimes the case. The second cut of the same figure is a modified form of the pocket arrangement, but should perhaps not be classed with it. The post rests in a bracket attached to the face of the sill, a provision being made on this bracket for attaching the diagonal rod.

The stake pocket did not prove altogether satisfactory, and a better if somewhat more complicated style of fram-

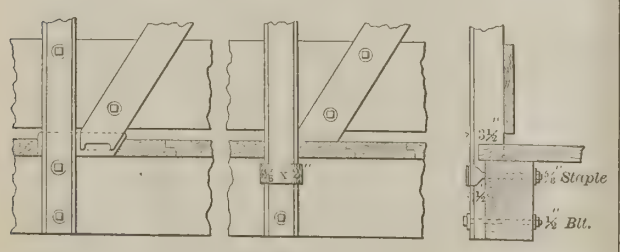
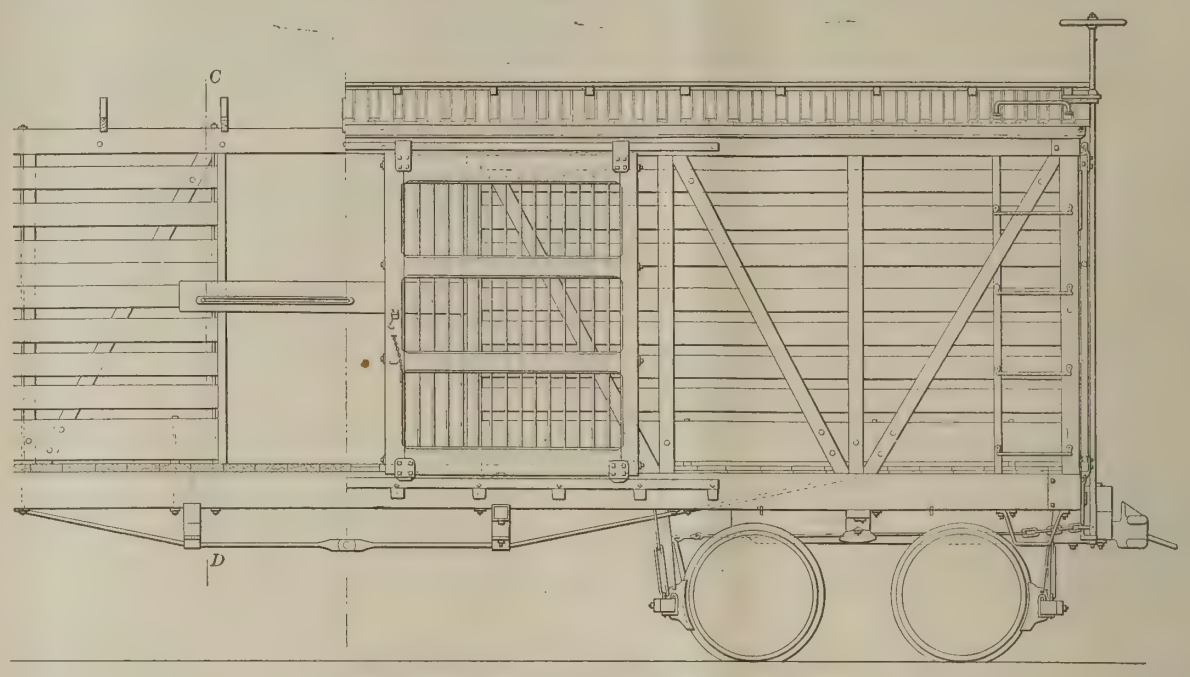


Fig. 57

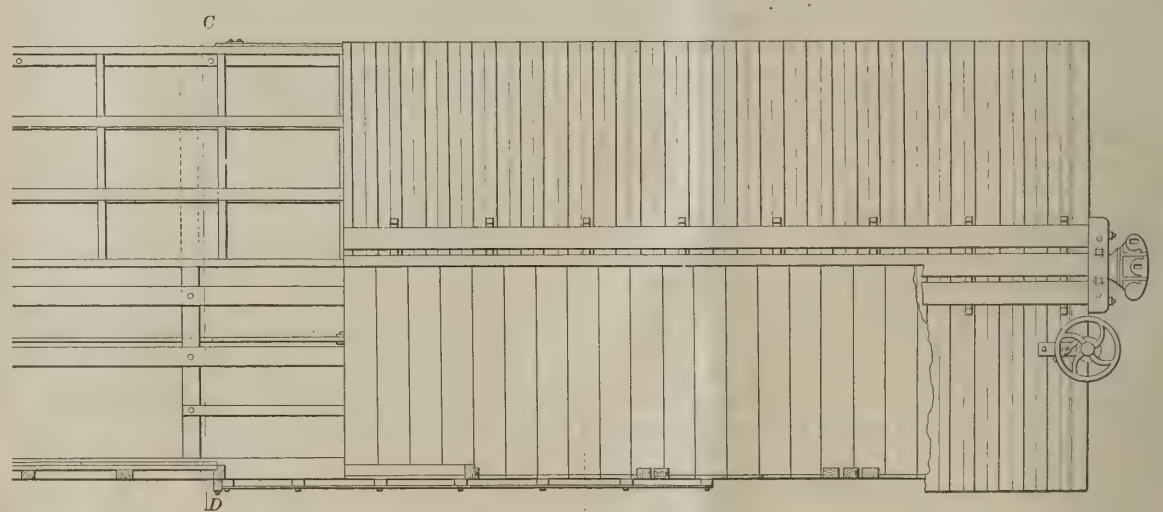
ing shown in Fig. 57 was the next venture. The post, which still retains its nearly square cross-section, is so shaped that a portion of it rests on the sill; the projecting part extending to its bottom edge is fastened to it with two bolts, or one bolt and a staple. The braces are set flush with the face of the sill in the usual manner, and are secured to the bottom slat with bolts, unless cast-iron sockets embracing both post and brace are employed.

The modern stock car, of which Fig. 58 is a fair sample, is framed more like a box car, the additional precautions taken with the posts having proved unnecessary. In the drawing they and the braces are attached to the sill without the intervention of shoes or sockets, but in most cases these are employed principally to keep the moisture from the matter collecting on the floor out of the joints, and thereby to prevent decay. For this purpose, the inner flanges are carried above the floor not less than one inch. The outside flanges are perforated or notched at each pocket in such a manner that any moisture collected in them is allowed to escape. The sockets are kept in position on the sills by projections cast on their under side and by the sill and plate rods passing through them.

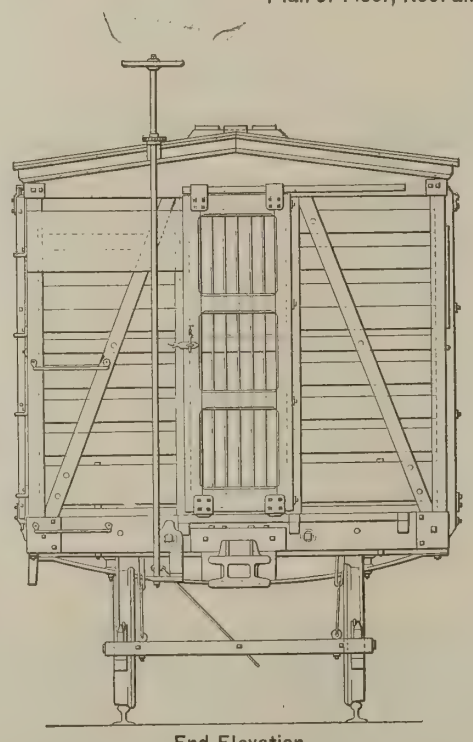
In Fig. 59 we have a construction which is up to date probably the best adapted for the purpose. The sockets being attached above the floor are not so bulky, the labor consumed in laying the floor is materially decreased, and the sills, as well as the posts and braces, are protected. Another advantage is the superior fastening of the sockets derived from the bolts used independent of the rods; by



Section at A. B. and Side Elevation.

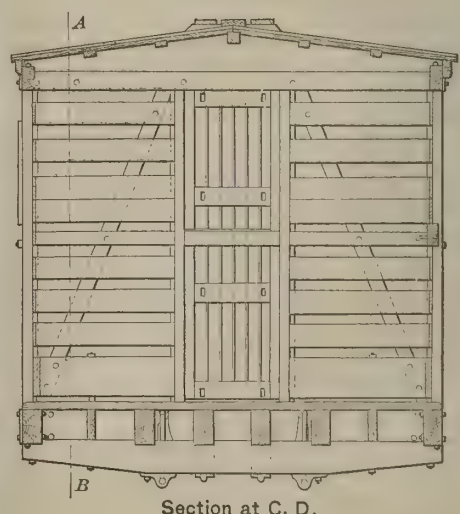


Plan of Floor, Roof and Framing.



End Elevation.

Fig. 58



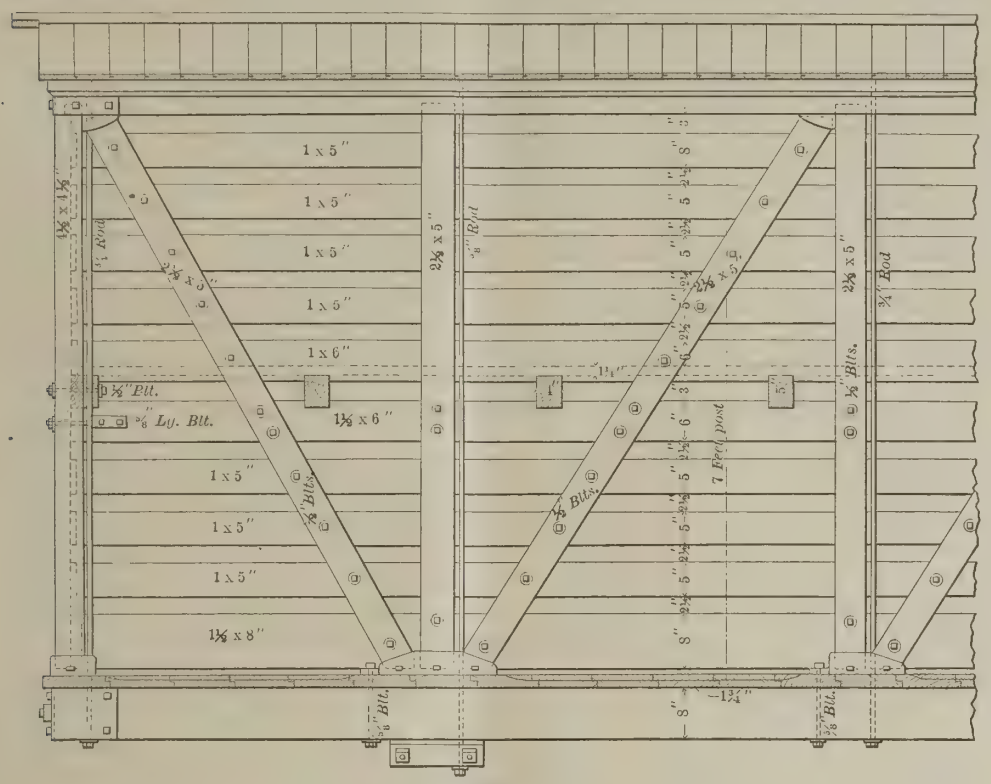
Section at C. D.

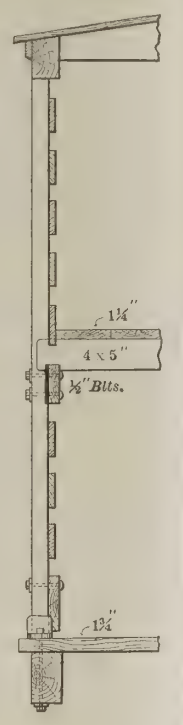
these the tendency to turn over is effectually checked. The renewal of a worn-out floor, however, is made more difficult; the rods and bolts have to be extracted before this can be accomplished.

One-inch slats of oak or straight grained hard pine, 5 or 6 inches wide, are placed on the inside of the frame, the corner and door posts being rabbeted like those of the box cars to receive them. The lower slat, with an open space of 1 or 2 inches between it and the floor, is usually wider—about 9 inches—as it is more liable to be broken than the others. For the same reason, and also to utilize it in supporting the load, it is frequently made 1¼ or 1½ inches thick, and is bolted to the sill in the same manner as the truss plank of a passenger car. The next four slats are applied with 2½-inch open spaces, the upper one of these, corresponding in height with the girth of a box car, is, again, very often increased to 1¾ inches, and is attached to the corner post with a lug bolt or plate, as in Fig. 59. The two or three rows of slats next to and commencing 2½ inches above the girth may be put close together, or one of 12 inches or more in width be used, both to protect the heads of cattle somewhat and to afford a sufficient surface for the lettering on the exterior. The remaining space above this is divided to suit the height of the particular car, the slats being from 4 to 6 inches wide and placed from 3 to 4 inches apart. Wire nails or screws are used for attaching the slats to posts and braces, but they should not alone be depended upon, especially when oak lumber is employed. A judicious use of bolts not adding much to the cost of the car will allay the annoyance resulting from loose and lost-off slats. The bolts used are ½-inch button headed, so as not to injure the cattle in transit, and are generally distributed as shown.

Double-deck stock cars require a slightly different arrangement of the slats from the above. All those above the one next to the floor are of equal width, and the

spaces between them are made uniform; the letter-board is omitted, the lettering being provided for by independent boards placed near the corners on the outside of the frame, or is put on the face of the side sill. The girths or slats carrying the deck beams are usually fitted to gains cut in the posts and braces, and are fastened with two ½-inch bolts to each. The upper floor or deck usually consists of 1¼-inch plank applied with joints parallel to the track and opposite in direction to those in the lower floor. It is supported by oak beams three or four inches thick by five inches deep, placed across the car at intervals of from 30





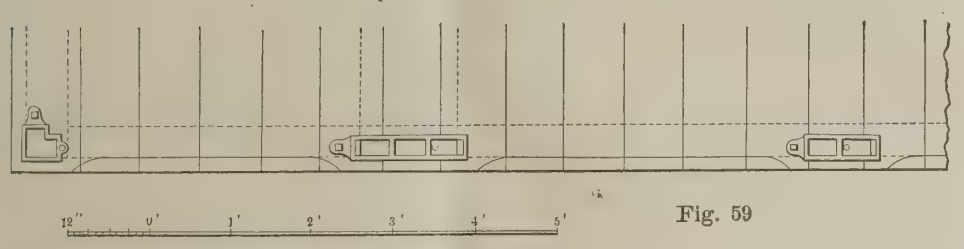


Fig. 59

o 36 inches. Two methods of attaching the ends of these beams to the side framing are employed. The one shown in the elevation and cross-section of Fig. 59 is similar to that used for the joists of a frame building. The manner in which both the beams and slats are notched secures a permanent and satisfactory job, with the least possible expense. Some other arrangement must, however, be

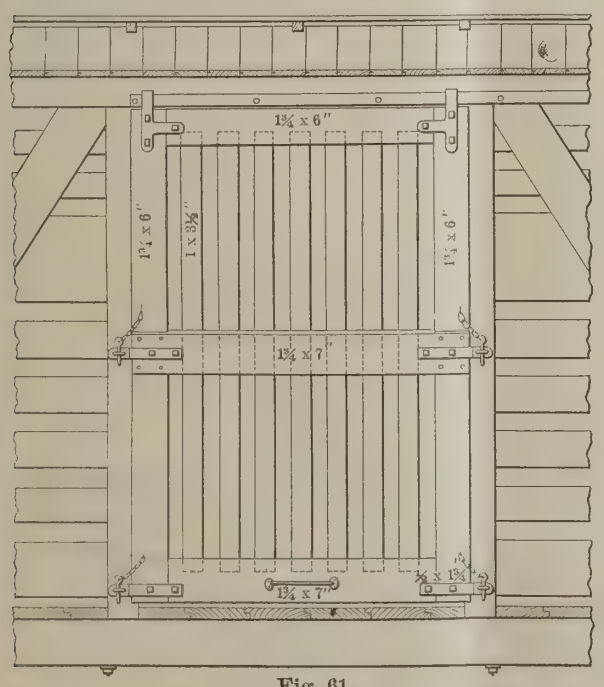


Fig. 61

provided at the door; the lower entrance would be too much contracted if the girth were allowed to extend across the opening.

In the second method, shown in the left-hand cross-section of Fig. 60, the girth is so placed that its lower edge comes flush with that of the beams, and can therefore be continuous. The beams are framed to it with a mortise and tenon and secured with a joint-bolt.

A third method, which is adopted when it is desired to temporarily apply a double deck to an ordinary stock car, is shown in the other cross-section of Fig. 60. The deck can with this fastening also be built in sections, narrow enough to be admitted through the side-door opening, and the converting from one class to another thereby much simplified and made less expensi[illegible] A bracket

shaped from ⅛ by 2-inch bar iron is bolted to the end of the beam and is hooked over the girth, but not otherwise fastened to it. The girth, itself, however, must receive an additional number of bolts to enable it to properly sustain the load.

Ordinarily the ends of stock cars are constructed in the same open manner as the sides, but of late years they have also been boarded up with the object of affording some protection in cold and stormy weather. The sheathing is usually applied vertically, the same as on box cars, and the whole end finished like these, the inside lining, however, extending from floor to plate. Just as effective and a more economical way of obtaining the same results would be to build the frame work to correspond with that on the side, with or without sockets, as the case may be, and to cover this on the inside with matched boards in place of the slats. In either case the distribution, size and framing of the posts and braces is much like that used for box car ends previously described.

The roof is either of the ordinary double-board variety,

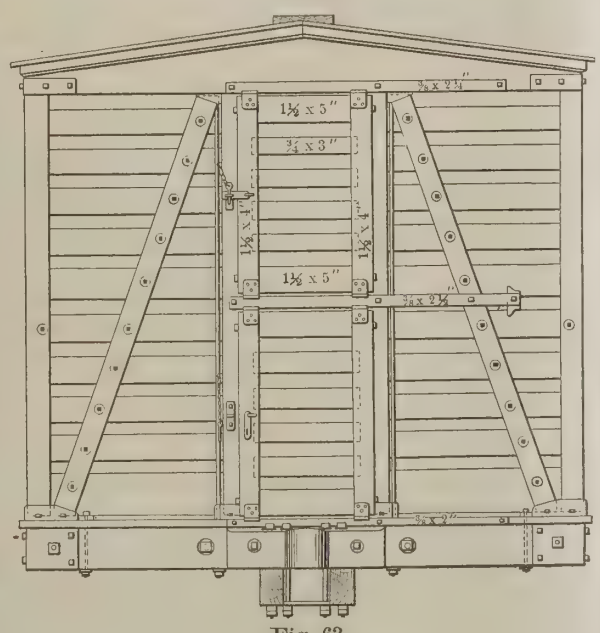


Fig. 63

or consists of a single course of boards with matched edges, or has these covered with separate battens. The single board roof is sufficiently reliable for this class of cars, and is at present much used; it can be applied at less than one-half the expense of a first-class box car roof if an inferior grade of lumber is used. The boards should, however, be sound and free from sap; the same quality used for covering the metal or composition roofs will answer.

Both side and end doors of cattle cars have the same location and general dimensions as those of box cars, except, perhaps, that the average side door is from 6 to 12 inches narrower. To describe or even enumerate all the different constructions of the door itself is impracticable and not necessary, although some of them possessing especial merit for simplicity and economy may deserve notice.

The average door consists of a frame put together in the same manner and with the same material in kind and dimension as that shown for box cars in Figs 51 and 54, for the sides and ends respectively. In place of the board filling, however, a series of 1 by 3 or 1 by 4 inch, hard pine or oak slats, or a series of ⅝-inch round iron rods is substituted. The slats are fitted to corresponding notches cut in the top and bottom rail on the reverse side, and are fastened with two screws at each end. The middle rail, in this case usually placed ⅛ of an inch in advance of the other members, is attached to the stiles as in Fig. 61, and is not gained for the slats. When rods are used as in Fig. 58, the middle rail or rails are bored to receive these, and are framed in the ordinary manner.

Nearly all the different methods introduced for operating box-car doors are employed, and in addition to these, the one in Fig. 61. The door is suspended from a rail or track at the top in the usual manner, while the bottom, and frequently the center, also is secured by hasps and staples when in position. This is done for the purpose of insuring a release from the filth collecting on the floor, which is specially annoying in winter, when it is liable to freeze to the door. With the other attachments this dif-

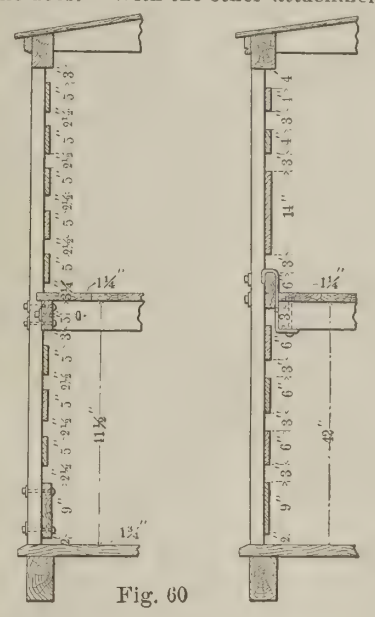


Fig. 60

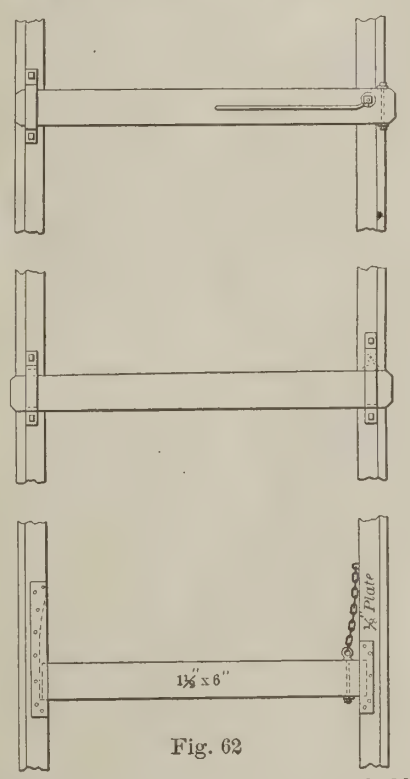


Fig. 62

ficulty is overcome by a three-cornered threshold of wood with the high edge set toward the door.

A bar of about 1½ × 6 inch oak is placed across the opening on the inside at a height of nearly 4 feet above the floor for the purpose of preventing cattle from coming in contact with the door and breaking it from its fastenings.

The same difficulty experienced with the grain doors is repeated here, and an altogether satisfactory way of attaching them has yet to be discovered. The three methods most used are shown in Fig. 62. In the first the bar is hinged to the right-hand post by a ⅝-inch bolt or lag-screw, but is free to slide on this by means of a slot necessary to allow the other end of the bar to be guided into a flat iron staple attached to the left-hand post, and long enough to admit of swinging the bar back out of the way when not in use. The right-hand end of the slot is curved upward in such manner as to effect a simple and inexpensive lock acting by the gravity of the bar itself.

The next cut shows the bar sliding on the protruding edge of the girth. A flat staple of ⅝ × 1½ inch iron is provided at each post and a similar one some distance to the right (this one is not shown). At each end of the lower edge of the bar is a notch at the same distance from each other as the two principal staples with which they engage. A small gravity button of cast iron, provided inside of the right-hand staple above the bar, swings in position both when the bar is in use and when moved back, insur-

ing a positive lock in both instances, and one that cannot be opened accidentally.

The above described attachments have the fault of taking up valuable space, and the protruding staples are liable to injure the cattle in transit. This fault is overcome in the third method. A socket is formed at each post by notching these and by the addition of light iron plates. In these the bar is dropped, as made plain in the cut. The bar is chained to one of the posts and its lower end supported, when not in use, in a bracket placed on the outside of the lower slat.

The fact that live stock is, as a rule, hauled in one direction from the districts where it is raised to the nearest Eastern market compels the cars built for this service to be returned empty in most instances; but, as it happens that at or near these centers are located the rolling mills for the manufacture of railroad iron, or rather steel, and this has to be transported in a contrary direction, these cars are made to do this service when practicable. It is very convenient for the proper and economical handling of this material to have a door at the end near the floor, and these cars are usually so provided. The upper end door is, however, not omitted, being necessary for the handling of lumber and kindred material. Both openings may be closed by one long door, as in Fig. 58; but the extreme narrowness of this door makes it rather fragile and difficult to operate. Another method provides an ordinary sliding door for the upper opening, and a door hinged on its upper edge so as to swing inward for the lower. Still another is shown in Fig. 63. Both doors are of the same pattern and slide on the outside in the same manner. The track at the center is used by both in common, and is for that reason made somewhat wider than usual; the other parts do not differ from those already described. The same double arrangement is sometimes used for closing the openings on the side of permanent double-deck cars; it will be found very convenient.

Axles for 60,000-Pound Cars.

(*Continued from page* 37.)

mit of considering a 70,000 or 80,000 pound car with 4-wheel trucks, and 33 inch cast iron wheels. The effect of heavy pressures on small wheels revolving at high speeds is well known by our experience with engine truck wheels. The smaller mileage is well attended to by the smaller guarantees wheel makers give and the growing demand for something that will last longer, shown by the gradual introduction of the steel-tired engine truck wheel. In a paper read by Mr. D. J. Whittemore, chief engineer of the Chicago, Milwaukee & St. Paul R. R., at the recent annual meeting of the American Society of Civil Engineers held Jan. 16, 1889, the opinion is expressed from facts presented that rail failure and, incidentally, wheel failure, do not result so much from abrasion as owing to the fact that they are submitted to pressures beyond their elastic limit. If this is the case now, will it be wise to load them still more heavily? But can we not learn something on this subject by looking at our passenger equipment? The question has already been met there. The loads on baggage cars, chair cars, dining cars and sleepers have increased so that in some cases the ordinary four-wheel truck and axle was no longer satisfactory. How is the question met? Do we increase the axle to unusual proportions? No. The simplest and most rational way out of the difficulty seemed to be to use the same axles but more of them, and so it is believed the question will be met when we are called upon to provide axles for freight cars of much greater capacity than our present heaviest cars, we will use, with some changes in the general dimensions and forms, the present M. C. B. axle and wheel, but more of them.

Is there not, however, another lesson that we may learn from our passenger equipment? When the question of automatic brakes for freight cars began to be agitated, a great impulse was given to all kinds of patent mechanical devices for stopping single cars, and cars made up so as to compose long trains. For a time we apparently lost sight of the fact that we had been using automatic brakes of a particular type for years. A careful and expensive investigation of the matter has resulted in bringing us back to the continuous automatic type that we have been so familiar with under our passenger equipment. Still more instructive is the history and development of the Master Car Builders' automatic freight car coupler. After spending large sums of money over all kinds of devices we have finally come back to one of the vertical hook types that formerly superseded the link and pin, and has been used quietly and successfully under passenger equipment for years. Can we not learn something more from our passenger car experience about heavy axles? We have already built heavier cars for passenger service than we are likely to for freight. The demands of our fast freight lines are making the services more and more alike. It used to be considered necessary, and the practice is still very general, to keep passenger engines exclusively for passenger trains, and freight engines for freight trains. The loads of our passenger trains of late years, however, have increased so materially, and the speeds of our fast freight trains have also so much accelerated, that the two services are now in some cases almost alike, both in tonnage and speed. On one of the western divisions of the Chicago, Burlington & Quincy, the similarity of the two services has become so apparent that we have pooled our through fast passenger and fast freight engines, a certain number of the engines hauling passenger trains in one direction and freight in the other. Could there be any more convincing proof of the growing similarity of the services? Much stress in the discussion on axles is laid upon the importance of having an ample bearing surface, so that there will be a maximum number of square inches to distribute the load over, making the bearing susceptible of better lubrication and consequently having fewer hot boxes. To a novice it might appear as though the only danger from hot boxes was on account of surface pressure, and yet we all know better than this. Every master car builder is aware that a large percentage of the hot boxes under our freight cars is the result of collar wear, and that this evil of hot boxes is not confined to surface pressure. Examine our scrapped brasses and see what proportion are worn out from end pressure and what proportion from surface pressure. Examine our scrapped axles and see how many are condemned for collar wear. It has been urged by some that axles will not pass through the successive graduations of 60,000, 50,000 and 40,000 pounds capacity service, on account of the collar, and that there will be little collar left after the first service imposed is accomplished. Could there be any stronger argument advanced for the necessity of a modification in lieu of the collar? Acknowledging that the collar has been productive of much bad work with our 40,000-lb. cars what endeavors have been made to meet the increased end thrust that certainly will be produced with 50,000 and 60,000-pound cars? Absolutely nothing, so far as recommendations are concerned. The design represented in Fig. 1 does not show any additional provision, nor do those shown in Figs. 2 or 3. Many of our master mechanics will recollect the annoyances from collar wear in crank pins and how successful the results are where it has been possible to do away with the collar. There is hardly a railroad in the country that does not have cars in its passenger trains with collarless axles, and while there are difficulties in the way of adapting it to freight-car service, owing to the construction of the freight truck, it does seem to the writer that it behooves each master car builder, in the interests of the road he represents, to be giving the matter consideration and at least to be making some tests and experiments with a few cars, to determine what modifications in trucks may be necessary. There has been a reason for doing away with the collars on our locomotive crank pins; there has been a reason for doing away with collars on so many of our passenger cars, and before car builders get themselves too heavily loaded with collar axles for freight cars of heavy capacity they will do well to consider whether the same evil does not exist as in the English crank pin and passenger car axle, and the same remedy apply.

In concluding, we are aware that by our failure to submit a design of such proportions and form of axle as we would recommend, we leave ourselves open to considerable criticism. We have, however, no intention to commit ourselves to any particular figures or form at this writing. To do so would only embarrass the other members of our committee and forestall any interest in our report to the parent club. The object of the paper will be accomplished if by bringing some phases of the question before you we renew some interest in the topic, and provoke all members of the Master Car Builders' Association to send in prompt replies to the circular of inquiry the axle committee have prepared, and which will be issued this week to each member.

Mr. C. A. Schroyer, Chicago & Northwestern, considered it a matter of the greatest importance that the distance of six feet three inches from center to center be retained, to enable the 60,000-pound car axle to be used under cars now in service. Thought an objection to the use of an eight-inch journal with this length of axle was the shortening of the space for the dust guard, which might cause the guard to catch on the journal shoulder. Recommended using a thinner plate and moving it a little further back. They have now in service 5½, 6 and 7-inch journals. Could not take a 7-inch journal and put it in where a 6-inch journal is used, because there is a difference of distance between centers. Result is that they have to throw away any number of axles, and he was anxious that such a necessity should not follow the adoption of a large axle.

Mr. Harvey Middleton, Louisville & Nashville, said: We have adopted the 60,000-pound axle for all cars that we are now making. When getting up our axles our object was to use our old centers, and, as Mr. Schroyer says, our old journals, if necessary. We retain the same figures for our bolt-holes. When adopting the heavier capacity cars it necessarily makes the dead weight greater, and we should endeavor to keep it down. This axle that we are using now weighs about 435 pounds. Several years ago we had considerable trouble in our passenger service with hot boxes, but within the last eighteen months we have

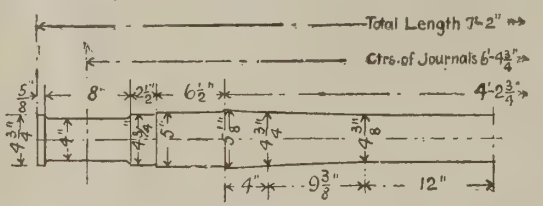


Fig. 1

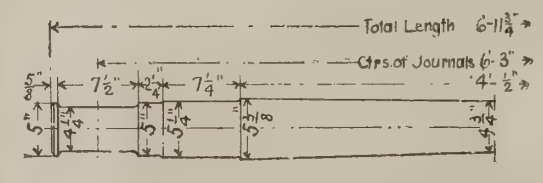


Fig. 2

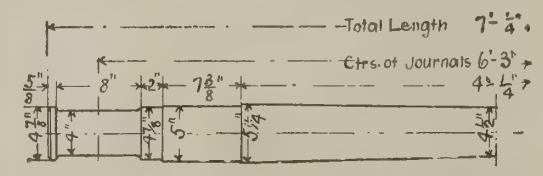


Fig. 3.

changed all the axles under our passenger equipment to 4 × 8 journal, and the point that Mr. Rhodes made is according to our experience. Since we put in those 4 × 8 journals a hot-box is now a rare exception, instead of being as it once was a common thing. Mr. Schroyer stated my feelings in the matter entirely. We have got to put in an axle which we can use in the minimum diameters, in our 40,000 pound cars, and this can be done.

The Chairman: What is the minimum diameter you are going to run them?

Mr. Middleton: We have adopted the Master Car Builders' sizes. In that respect we come to the M. C. B. rules. I will state that we have from 2,500 to 3,000 of these axles under our freight cars, and all of our passenger cars.

The Chairman: Is it your idea to introduce them under cars of lighter capacity when you have done with them under the 60,000-pound cars?

Mr. Middleton: Yes.

The Chairman: You have to decrease the length of the journal then, don't you?

Mr. Middleton: Not necessarily; only to have the brass made 3¾ or 3⅝ diameter, as it may be, instead of 4 inches, which is not an objection at all.

Mr. Snow, Illinois Central, said that they were using an axle 6 feet 2 inches between centers, the journal being 4 × 7 inches. He would prefer a journal 4½ × 8 inches.

Mr. B. K. Verbryck, Chicago, Rock Island & Pacific, favored an axle 4¼ × 8 inch journal. With such an axle a load of 70,000 or 80,000 pounds might be carried safely in a car.

Mr. Middleton: We want an increased bearing surface in order to get better lubrication, as Mr. Rhodes states, and I think that 60,000 pounds on four-wheeled trucks is about as far as we can go. I think when it comes to the bearing surface there is very little difference between the 4 × 7 and the 3¾ × 7, but we must have increased bearing surface in order to help the lubrication, the same as we have done with our engines.

Mr. Schroyer asked Mr. Rhodes to give his views as to the proper dimensions for a 60,000-pounds car axle.

Mr. Rhodes was not prepared to recommend particular dimensions of a large axle.

Mr. F. Wilder, United States Rolling Stock Company, directed attention to the importance of keeping the distance between centers as short as possible, since it reduced the leverage strains on the center of the axle.

Mr. J. Setchel, President Railway Master Mechanics' Association, said: Mr. Rhodes has suggested a point in his paper that I think is well worth considering. We desire to have our car service, that is, trucks, boxes and arch bars, so constructed that we can change the axles from one car to another; now it seems to me that so far as freight service is concerned there will not be a great deal of that done. I have always made it a practice of using axles from passenger cars, after a certain length of time, in freight service, and I think it is very well to have the equipment arranged so that that can be done. But that has been done only from motives of safety, and it seems to me that in the freight service you will rarely find car builders changing a larger axle to a car of less capacity, unless it it is a very poor car, because we are getting so now-a-days that we regard a car a great deal as it looks. I have been informed since I have been sitting here in the club that on a road which has quite small journals and axles, they recently discovered cars loaded to 50,000 pounds. Now that will be the case, and it seems to me that there will be very little changing from larger to smaller axles. As Mr. Rhodes has suggested, why not add another axle to our freight equipment? That will keep the boxes and axles uniform. It will add another axle and another pair of boxes, and increase somewhat the cost of the truck, but if we are doubling our carrying capacity can we not afford to do that? Will not our arch bars wear longer, and will not our wheels wear longer, and will there not be a greater degree of safety than with the four-wheeled truck? Then we could use our axles of uniform sizes and there would be no trouble about changing boxes, nor anything else, and no mistake made about the capacity of the car.

Mr. Schroyer: I don't know whether Mr. Setchell has any reference to the Chicago & Northwestern cars or not. We have some gondola cars marked 50,000 pounds, which have the M. C. B. axle. Before they were marked 50,000 pounds it was given due consideration. A great deal of the difference which exists between the marked capacity of those cars and the marked capacity of our box cars is in the dead weight of the car itself, so that we think we are safe. Now, I think that if we adopt an axle having 6 feet 3 inches from center to center of journal, the matter of the diameters will cut but a very small figure, if we keep our diameters anywhere inside of the centers of those two bolt holes. We can increase to where those bolt holes will allow us to go. If we take 6 feet 3 inches from center to center of our journals, and put in 4 × 8 journal it is a matter of very small importance, changing those from 4 inches to 4¼ inches diameter. The only labor involved there is increasing the width of the two plates, or taking the old ones out and chipping them enough to admit your journal.

If we want to get some understanding as to where we are all standing on this subject, it would be a good idea to have an expression of the members on the different points, and to that end I would make a motion, that it is the sense of this meeting that 6 feet 3 inches from center to center of journals is the proper length for 60,000 pound capacity car. Seconded.

Mr. Verbryck: Regarding six-wheeled trucks, I don't think we shall ever come to that with freight cars, on account of the difficulty of putting in wheels. It is a good deal of trouble putting in the center wheel. You have got to take out two pair of wheels to get one pair in. I have come to the conclusion that a four-wheeled truck can be used very successfully with a 60,000 pound car, and I am of opinion that 60,000 pounds is as much as any one car ought to carry.

Mr. Rhodes: I wish to refer to one position which my friend Mr. Setchell, has taken, regarding the use of axles when too small for one service into another. In freight equipment that is coming up every day. At the last Master Car Builders' convention a resolution was passed limiting the size of wheel fit, if I recollect correctly, to 4¾, that no axles were to be refitted under freight cars that had a less wheel fit than 4¾. Now, at this date, there are thousands and thousands of cars running with axles less than 4¾ in the wheel fit and running safely. I was asked the other day by one of our master mechanics how we should act in that matter. Should they be condemned? It seems to me that the question of economy in this matter of axles, is going to come up, and that it will be a grand and economical thing for us if we adapt that axle so that we can use it in a 60,000 pound car, and then when it is too small, under a 50,000 and so on down. I know of one road with 30,000 or 40,000 cars now in service with wheel fit, probably no larger than 4½ inches in diameter, and they are running safely, and it is not economy to scrap them. Those are not cars of 28,000 and 30,000 pounds capacity, but cars of 40,000 pounds capacity.

The Chairman: Do you not imagine the revolutions have something to do with the carrying of the axle?

Mr. Rhodes: On that question I know that many persons hold different views. I think the reason is not because we have used, large axles and they have crystallized, but that we have used too small axles. We have used them until they have become strained and broken, and that has given us the idea that axles after a certain service crystallize and are no longer safe. I remember very well on a certain railroad that the axles in the passenger equipment, steel axles, were limited to 50,000 miles and after that they were condemned. The diameter of those journals was 3¾ × 7 to commence with. The other proportions of the axle were very similar. Now it seems to me very plain that that axle was too small to begin with, and that by being constantly strained beyond its elastic limit, after being some eight or nine months or a year in service it would break. Later on the axle was increased in diameter, and the result was that the limit was raised to 100,000 miles. Still later on the diameter was increased more and the result was that there was no mileage limit placed on the axles at all. I think the reason many of us have got the idea of axles failing after a certain mileage is because we have used too small axles. They have constantly been strained beyond their elastic limit, and the result is an eventual failure and breakage of the axle. Now that we are proposing axles of dimensions that will not be strained beyond their extreme limit, I for one do not feel any fear in that matter, for the reason I have just given, past experience. I am safe in saying that my having no fear in that matter is backed up by experience.

The Chairman: We have with us Mr. Hughes, locomotive and car superintendent of the Northwestern State railways of India. I am sure we should all like to hear from him on this question.

Mr. Hughes: Mr. Chairman, for many years past we have been taking axles from our heavier wagons and working them under the lighter ones. We are using entirely steel axles. When I commenced on our road about fifteen years ago the journals were 3¾ × 8; I am now running 4¾ × 8, and find them most successful.

Mr. Schroyer: In support of my motion I want to say another word: Mr. Rhodes, in his paper, lays considerable stress, and justly so, on the side thrust being taken by the brass, which you all know to be the fact. There are some roads that have constructed a box with the special object of having the end of the box take the thrust from the face of the hub. Some years ago we got up a box with that object in view, for the reason that we wanted to run a blind wheel for a center wheel in a six-wheel truck. The result is we have no side thrust on these wheels, and we find that there is enough lubrication to keep them lubricated at all times. In new boxes constructed for a 60,000-pound car this can be carried back another half an inch farther, which will give you just as much play at that point as we now have. It is abundantly heavy on the sides to take a thrust of that character, simply because it is the side plates of the box that come directly in contact with the face of the hub of the wheel. There is sufficient metal at the sides to take the thrust. I believe that the only objection that can be offered to the 6 feet 3 inch center is in the construction of this box at the rear end of it. Mr. Snow tells us that he is now running them 6 feet 2 inches from center to center. If he can run that journal in that condition it is precisely what we are aiming at with the 8 inch journal. He is doing with his 7 inch journal just what we want to do with the 8 inch journal.

Mr. Verbryck: That is exactly the way I have been doing for the last eight years past. I allow only a quarter of an inch play, and I have found it to be very successful. That box will wear away in use, but I find it wears very slowly. We build them right close up to the wheel.

Mr. Middleton: So do we, and we are meeting with good success.

Mr. Snow: All the cars that we have built since 1880 have been built with the box up against the hub of the wheel, and we don't allow more than an eighth of an inch. But they will wear off. I have seen them with at least half on inch on each side. I put up one car with a 4½ × 8 journal, without any collar, and that is running yet, and the last time I saw it it was all right. I should be in favor of the 6 feet 3 inches between centers.

After a little more discussion the motion was carried and the discussion closed.

Communications.

The Metric System of Measurements.

To the Editor National Car and Locomotive Builder:

Referring to the resolution adopted by the New England Railroad Club at the meeting held in Boston in January, recommending that a committee be appointed by the Master Car Builders' Association relative to the adoption by the railroads of the country of the metric system, notice of which appears in the issue of the NATIONAL CAR AND LOCOMOTIVE BUILDER for February, and also editorially on the same date, the writer naturally takes great interest in any attempt made to arrest what has already been begun to simplify the details of car construction and the many important general requirements of American railway service. This certainly has a tendency to retard the general adoption of such standards, whatever may be said to the contrary by the promotors of the metric system, and to inspire a feeling of cautious hesitancy on the part of those who may be willing and even anxious to adopt a standard of whatever system may be officially recognized; hence at this time a statement of some of the reasons why the metric system fails to meet the requirements of practice, and the presentation of positive evidence in argument against the adoption of the metric system may not be out of place in your columns.

To begin with, the car-builder uses timber which is measured in feet and inches. The sizes in common use are the same all over the world. The use of the unit of measurement of the inch or the foot tends to unquestioned economy of figures in expressing dimensions, as any one will at once appreciate by undertaking to convert into metric equivalents the sizes in common use, and which will be practically retained whatever may be said to the contrary by metric advocates.

Iron, in rounds or squares, is made in sizes by inches and the binary subdivisions of the inch, and the sizes in common use are memorized with ease. Thus we have sizes by sixteenths up to one inch, eighths to two inches, quarters to three inches, and half inches up to larger sizes.

The introduction and adoption of the Sellers or United States Standard system for screw threads by the car-builders and by the railroad companies of this country has become so thorough that no change can be made in this department of interchangeable details of construction, because the sizes have become fixed by the great number of tools and gauges which represent them; and costing a great deal of money to establish. Certainly there can be offered no good reason why they should all be thrown away merely to be substituted by a system which has little, practically, to recommend itself.

By introducing the metric system, these sizes can only be expressed by new names, involving the use of an array of figures which cannot be readily memorized, as the sizes themselves must remain the same. This has obtained in France and in Germany up to the present time, although the metric system has been by law the standard for both countries for a number of years. Lathes are still in use there, having the Whitworth pitches for their leading screws, and in many instances bolts and nuts are made to correspond with the Whitworth standard, the sizes being merely expressed metrically; as for instance, a one-inch screw being called 25 millimeters, the nearest equivalent in whole numbers which is available.

While in the English system of measurement almost any ordinary dimension can be readily expressed in few figures, how different becomes the case when the metric system is applied. Any dimension above about one-half inch requires two or more figures to express it, and a dimension approximating so simple a case as 5 feet 9 inches, the ordinary height of a man, becomes in the metric system notation 1752 millimeters or 1.752 meters. Who would care to burden their memory with such a row of figures, when the former simple, easily remembered equivalent states the fact perfectly. Even French novelists make use of the feet and inch unit to express a man's stature, evidently for the reason above mentioned.

As is so admirably put in the editorial referred to, the attempt to convey an idea of taper bolt dimensions metrically, leads the machinist into a maze of decimal figures which is simply out of the question to seriously consider.

In the drawing-room of the car department of any road or manufactory, dimensions given in feet and inches are easily read and easily added for obtaining total length, which in the case of the use of the metric system involves the addition of a column of figures which might often require the services of an expert accountant to satisfactorily accomplish in the time that any one of ordinary mathematical ability could do it, by the simple addition of the integers of feet and fractions reduced to sixteenths.

Let any one who may doubt this statement attempt to add the following series of dimensions, in order to obtain the total length of various parts between the frames, including panels, etc., or the length of a shaft, including different sizes, lengths of journals, spaces between for pulleys, gears or other purposes—$4\frac{1}{16}$ inch, $5\frac{1}{2}$ inch, $8\frac{5}{8}$ inch, $3\frac{7}{16}$ inch, and $8\frac{1}{4}$ inch—the whole number equaling 28 and the fractions reduced at a glance to 30 sixteenths, or $1\frac{14}{16}$ inch, gives us at once the total length as $29\frac{7}{8}$ inches. Presuming that these sizes are fixed, attempt to attach to each its equivalent in the metric system, and the result is seen in values, each requiring at least three decimals to denote it, with the necessity of using a pencil as an aid to avoid mistakes, besides making it impossible to easily memorize even the result.

As the meter is too large for general use, the millimeter must be adopted in ordinary practice, though the centimeter and the decimeter are both used in certain applications, but only to a limited extent, so that if all ordinary dimensions are to be expressed by the multiplication of so small a unit, a moment's reflection will convince any one that it becomes impracticable, even if the most conveniently written sizes are adopted for every possible dimension, without mentioning at all the reduction of sizes already permanently fixed in English measure, should the metric system in any case supplant that which is now so generally used by English speaking people all over the world.

In the careful consideration of the advisability of introducing the metric system into the railroad service of this country, two important conditions must not be overlooked. These are that true economy compels the use of the fewest possible shop sizes, and these sizes to be so simple as to be easily memorized.

We have already noted the comparison of these two conditions as between the metric and the English systems of measurement, with the additional argument in favor of the latter by reason of standards already firmly established which are not likely to be changed, yet another element of disturbance should be mentioned here in this connection, which is the enormous number of tools, such as taps, drills, reamers, counter-bores, mandrels, arbors for cutters, thread and size gauges, requiring complete "re-sizing," if the coining of a word may be permitted here, of the outfit of every machine shop of the country to accommodate these sizes to the new order of things without a single advantage in its favor, and considerable to be said *per contra*.

As already stated, these fixed sizes cannot be thrown away and convenient metric sizes replace them, so that the re-stamping and confusion resulting is not pleasant to contemplate. These fixed sizes cannot be easily thrown away, whatever may be said by the advocates of the metric system as to the ease with which the change can be made without a loss of actual capital, such as no railroad company or machine shop owner would be willing to incur.

It is unnecessary to dwell longer upon what has been so clearly shown in the editorial in the February issue referred to, and in leaving this part of the subject mention should not be omitted of one of the curiosities of the metric system in its actual application "at home," as it appears in France at this time. It was related to the writer by Prof. Coleman Sellers, that by his personal observation while in Europe, butter is sold at retail by the half kilogramme, in order to approximate the weight of the English pound as being more nearly the unit for greatest convenience for this purpose (the kilogramme being equal to 2.2 pounds, nearly), and more than this, the subdivision was still further carried out by halving, quarter kilos being used for small amounts in preference to the subdivision by tenths, about which we hear so much as to its superior advantages. This is certainly an illustration of the practical adaptation of the binary system of subdivision common in the use of English weights and measures.

At the meeting of the club, in the discussion on this subject, considerable stress was placed upon the use in England of the units of weight and measure such as the "stone," "long ton," "perch," "furlong," etc., found in the tables of old English weights and measures, which, while old records in this country may include them to some extent, is no index whatever of the necessity of their general use in the United States, and certainly not in the shops of the railroad companies of this country.

The conversion into the metric system of existing records of land titles, etc., now in English measure, in the event of its being necessary to do so, would obviously entail an enormous waste of time and an expense entirely out of all proportion to the advantages proclaimed by the most enthusiastic advocate of the metric system.

It is curious to note that to this day manufacturers of spectacles in France retain the use of the old French inch unit, or "pouce"—equal to 1.0658 inch—and then reduce to metric equivalents, afterwards converting them into an optician's scale, which has no significance whatever as to the advantages so often attributed to the metric system.

It is also interesting to find in the published price-lists of manufacturers of twist drills in Alsace, that in the range of sizes varying by one millimeter, from 1 to 100 millimeters, the sizes which closely approximate those ordinarily used in English measure ($\frac{1}{4}$ inch, $\frac{5}{16}$ inch, $\frac{3}{8}$ inch, $\frac{7}{16}$ inch, $\frac{1}{2}$ inch, $\frac{9}{16}$ inch, $\frac{5}{8}$ inch, $\frac{7}{8}$ inch, etc.), appear in bold-faced type, to designate at a glance which are most used, and shows at once how firmly established in the minds of the people, even in countries where the metric system is the national standard, are these English sizes in the machine shops and practice of Europe, actually compelling the conversion of them into metric equivalents as a recognition of this fact. How much more difficult, as already stated, is the effort to memorize the sizes given above if put into millimeters than if simply stated in "old-fashioned" fractions, which any one can easily understand and remember. We must not overlook the fact, also, that the every-day use of the ordinary sizes is by the mass of workmen who are not familiar with fractions expressed decimally, and which often are to them a perpetual mystery, as evidenced in the fact stated by Prof. Sellers, that the shop-keepers of France cannot, or do not, use decimals in any way in their practice of making change.

Reference having been made during the discussion of this subject by the Railroad Club that if all the old measures should be destroyed beyond recovery it would be almost unanimously admitted that the substitution of the metric system in their place would be much better than is now or has been used, we can only reply that in this event it would mean the destruction of almost everything which we call civilization in this country, and its restoration would in time evolve into being a system of measurement which has already been the "survival of the fittest," for reasons which have been already presented in this connection.

The statement made during the discussion that the Pratt & Whitney Company, in the execution of the contract to supply the machinery for the three German government armories some years since, found no difficulty whatever experienced in working to the metric system in carrying out this contract, is true only so far as it refers to what was actually stipulated in the contract, the gauges, tools and fixtures for the manufacture of gun parts having been made to the metric system by means of the use of vernier slide gauges or calipers, which any ordinary tool-maker can learn to read and operate quite as easily as if graduated to the English standard, as it requires practice to do so successfully with either system, the bare fact of following specifications in either system being of about equal significance, and possibly within about equal degree of accuracy in attempts to establish original sizes by the use of such an instrument of precision. Hence this can be no argument in favor of the use of the metric system, and furthermore, the specifications required all screws to be made to correspond to the Whitworth standard, a very significant fact, worthy of the attention of those who endeavor to urge the use of the metric system as one adopted by so many foreign countries, and therefore so much more "universal" in its application.

The fact may also be here stated that the regular machinery sent to Germany on this contract was built from drawings having every dimension in English measure, no attempt having been made to convert English sizes into metric equivalents, nor were any changes made to conform to convenience in expressing such dimensions in metric sizes.

Referring now to what is certainly most conclusive evidence of the undesirability of the adoption of the metric system in the machine shops of this country, the experience of Messrs. William Sellers & Co., in the injector department of their works, by which the use of the metric system during nearly forty years has demonstrated conclusively that it is not practicable as a system for securing economy either in application of sizes or in the designation of these sizes by figures, requiring more time for workmen to understand and more difficult for them to memorize, and being carried out independently, without a possible chance for conflicting with the English standard of measurement in use in the main departments of the works, any advantage surely would be recognized if inherent in the system; but during a recent interview with Prof. Coleman Sellers, he stated that this careful, unprejudiced trial of nearly 40 years has firmly convinced them of its utter impracticability and its inferiority as compared with that of the English binary system, and that if it was possible for them to do so its use would be at once discontinued. But as all sizes for tools, gauges and fixtures are now so firmly established, and duplication of old parts constantly recurring, this cannot be done. So that a system far inferior in many respects must be retained, and its defects endured for the same reason that obtains, in one respect, should the English system of measurement be thrown aside by the shops of this country—its excessive cost in dollars and cents—outside of any consideration of fact as to convenience or simplicity.

As for the use of the metric system by the watch factories of this country, so often referred to with pride by the advocates of the system as an example of its successful adaptation in this wonderfully developed industry of the country, the writer would here state that on the occasion of a recent visit to the factory of the Waterbury Watch Company, this subject was mentioned, and the officers of the company stated that the conclusions reached by them in their experience in the use of the metric system were decidedly against its practicability and economy in everything with which they have to deal, and after a thorough trial of it, from the very beginning of the business, are convinced that it is a failure and has resulted in serious loss to them in many ways, by increased cost of tools, such as taps, gauges, etc., made for them to order, while the serious inconvenience and positive loss in one instance, which might here be mentioned, resulting from the use of metric set screws having slotted heads in the pulleys on their main line of shafting. The impossibility of tightening them sufficiently to hold, and the failure to find in the market square head set screws to replace them, even approximating the pitches of the old ones, required a complete change of pulleys, using new tapped holes, having sizes and pitches

which are of regular standard sizes, found readily in stock demonstrated the non-existence of even an interchangeability of ordinary screw thread sizes under the metric system, which obtains even now in Europe where the system is presumed to be in successful operation.

The result has been, on account of the many vexatious circumstances connected with the Waterbury Watch Company's experience with the metric system, that all new work, whether screws, fixtures or special machinery, is made to conform to the English standard of measurement, and the threads of all taps, even those which are still retained in the metric system, have the Sellers form of thread, though of finer pitches necessarily for this class of work, while many of the taps are actually strictly United States Standard both in form and pitch.

It is hardly necessary to attempt to enumerate the various expensive changes which any machine shop would be obliged to make in the event of the introduction of the metric system, universally, in this country, nor to undertake to estimate the enormous tax upon the entire population of the United States by the change of every unit of weight and measure now in use, it must be left with those who may have the time to do so; and in conclusion the writer would ask whether any advocate of the metric system is prepared to state, even approximately, what such a change might cost, say, for instance, for one machine shop, em ploying 600 men, equipped as it may be now, with all the modern small tools necessary for successful competition in the markets of this country only (in the matter of measures of length only, to simplify the problem), and if he has not the data at hand, or the experience, such as a practical man should have for the purpose, the writer can only say that a works such as that of William Sellers & Co., or the Pratt & Whitney Company could furnish him valuable assistance, and thus make the report one which might cause him to hesitate before making public the information thus correctly gained. George M. Bond,

Manager Gauge Department, the Pratt & Whitney Co.

Hartford, Conn., Feb. 23, 1889.

Steam Heating on the Vandalia Line.

Editor National Car and Locomotive Builder:

The question of the practicability and economy of heating passenger trains with steam from the locomotive being to the fore at present, I give you below the results of a series of tests made on this line with the Martin system.

The coach used was of modern build, inside length 55 feet, width 9 feet, heighth 9 feet 2 inches, containing 290 feet of two inch radiating pipes placed in two lines on each side near the floor, with a spur under each seat. The figures given are the averages of ten trips of 183 miles, in temperatures ranging from 8 degrees to 45 degrees above zero; the figures given include heating up the car at each end, but this cost was determined and is given in a separate column. The figures given probably approach the truth quite closely, but of course are not claimed to be absolutely correct.

Amount of heat used in.	Averages.						Average Cost per Trip.				Cost per 100 miles run.	
		Temperatures.										
	Pressure of steam.	Of condensation.	Of water in tank.	Outside.	Inside.	Amount of condensation per trip.	Units of heat.	Pounds of coal.	Per cent.	Coal used heating up car.	Pounds of coal.	Cents.
	Pounds.					Pounds.				Pounds.		
Conducting to car							21,350	4	.027			
Actually heating car	11 8-10	142°				661	691,075	134	.887			
Wasted at trap							66,100	13	.086			
Total drawn from locomotive	118		42°	28°	67°		778,525	151	1.000	12	71	5

Five thousand one hundred and fifty-seven units of heat to 1 pound of coal taken as a basis.
Coal on tender, $1.40 per ton.

A comparison between the trips on warmest and coldest days indicates that the cost of heating an average coach will approach very closely to one pound of coal per car per mile with zero temperature.

During the trials the evaporation on the engine was taken, resulting in an average of 5,157 units of heat to one pound of coal. I am aware that this will be considered low, but it averages very well with trials made on other divisions during the winter months.

A steam gauge was placed inside the car and connected to the pipes where steam was admitted, the trap was piped to a reservoir where all condensation was collected; in this pipe and close to the trap was inserted a thermometer arranged so that the condensation constantly flowed over the bulb; the trap was set to close at about a temperature of 145°; usually they are set so that the condensation escapes at about 210°. Had the tests been made under those conditions the waste would have been not less than 15 per cent., instead of about 8 per cent., and the latter could be very much reduced. My experience on these trial trips leads me to favor a plain common sense system of piping a car, allowing the condensation to escape as soon as *all* the heat is extracted. Heat costs money, water so little as not to need consideration.

At the January meeting of the Western Railway Club considerable was said about the difficulty of regulating the temperature, the cars generally being too hot. In order, then, to regulate the temperature, and at the same time extract all the heat practical under the varying conditions, the best way would seem to be to pipe the cars in excess of present practice, and instead of trying to control the temperature by the steam pressure, arrange to govern it at the trap by suitable connections inside the car, arranging so that the water cannot be retained at a less temperature than, say, 60 degrees, to avoid danger from frost, and cannot be opened wide enough to allow steam to escape. Between these extremes, let the trainmen govern it by the aid of a suitable lever and index. Suppose a car thus equipped is about to leave a terminal station, the outside temperature being 40 degrees; the regulator is turned to "Shut" and the steam turned on. Our experience shows that under these conditions about four gallons of water will be condensed in bringing the temperature of the car up to 70 degrees, and that very little of it will reach the trap at less than 60 degrees; it will consequently close and allow the condensation to back up, partially filling the radiating pipes and reducing their temperature. Should the temperature fall it would only be necessary to move the regulator so as to open the trap wider, allowing the water in heating pipes to be replaced by steam increasing their temperature until the proper proportion between steam and water is established; the heat contained in the water thus backed up is generally extracted until it reaches the temperature at which the trap will let it escape. Yours truly,

F. C. Cleaver, Master Mechanic.

Defects of Car Heating by Steam.

Editor National Car and Locomotive Builder:

I notice none of the car heating systems which use steam from the engine have sufficient drainage capacity. They all start out with warm cars, but in less than 75 miles the car grows cold, when, unless the car is "tapped" by the employés, the pipes are so full of water that circulation is impossible, and in consequence the cars grow cold. What is needed is either efficient and effective trappage, or the means placed within the hands of the train hands of draining the cars from *the inside* when necessary, in place of, as at present, having to wait the completion of a run of 75 to 100 or 150 miles. Traveler.

Variable Exhaust Nozzle.

Editor National Car and Locomotive Builder:

A new variable exhaust is offered to the railroad world, I notice. Possibly most master mechanics may think with me that valuable exhausts are good on paper and when new, or for 150 miles; but after that the attention necessary from the round house crew, due to the absolute incomprehensibility of the average locomotive engineer to any new idea, makes such schemes very expensive.

The trouble is not so much with the device as with the ignorance of the engineers and others, whose duty it should be to make any improvement a success. M. M.

Questions Regarding Interchange of Cars.

Editor National Car and Locomotive Builder:

I would kindly ask for a small space in your valuable paper and your opinion on a few questions pertaining to the interchange of traffic, on which there seems to be a vast difference of opinion among the different railway officials. I refer to rules three and four of the Master Car-Builders' code governing the interchange of traffic. First. Does rule three cover all defects for which wheels may be refused? Can a connecting line demand a defect card for wheels with flat spots less than 2½ inches, or for seams on tread less than 3 inches long?

Second. In case a foreign company offer us a car which has one broken or badly damaged draft timber and there is a release card given for same, and car goes on its way, before it returns to point where received this defective timber gives out, and, in consequence, the other timber is also broken, who is liable to damage for second timber, the company who gave the card for the first damaged timber, or they in whose possession the car was when second timber gave out?

Third. Rule six of the M. C. B. code says that no card shall be honored as voucher if presented later than six months after date; what are we to do in case an Eastern car arrives here with a defect card on for one cracked or damaged sill a few days before this card shall expire, and while on our road, but after the six months are up, the car breaks down and we have to do the repairs, is it right that we should stand the loss of this sill? Or if car comes back a few days after the six months are up in same condition as when received, can the connecting line demand a new card from us for the sill?

Minneapolis Inspector.

[We do not see where there is room for a difference of opinion on the first questions asked. The rules of interchange appear to cover all defects for which wheels should be rejected, and they say distinctly that wheels *may* be refused for a flat spot over 2½ inches long, or for seams on the tread 3 inches long. If the flat spot or the seam is less than the length given a receiving road has no right to demand a card. In the second case we believe the company that gave the card ought to be held responsible for the breaking of both timbers. In regard to the third case, there ought to be honor enough among railroad companies in their dealings with each other to prevent any dispute about payment because the rendering of the bill was delayed.

We should like to receive the views of master car builders on all the questions raised.—Editor.]

Malleable Iron vs. Steel.

Editor National Car and Locomotive Builder:

One would judge that the numerous articles appearing in your paper on the subject of "Malleable Iron vs. Steel" had been so well explained and thoroughly discussed, that no one could be found connected with the mechanical departments of railroad companies or general manufacturing who was not fully up on the subject of the use and suitability of malleable iron for such purposes. Yet "Another Car Builder" exposes his limited experience to the world through your February number.

Malleable iron has been used in the last few years very largely in car construction, mowers, reapers, etc., and no substitute has been found that would fill its place at anything near the cost.

Steel is used very largely and successfully for certain parts of locomotive, stationary and marine engines, and the writer has had occasion to recommend it for such work, but when one takes up the car question no able argument can be made why steel should be substituted for malleable.

Where after seven years' service in car construction and repairs can be found any material that has more friends than malleable iron? If "Another Car Builder" will make himself known there are many of his co-workers who can give him their experience in the use of malleable iron. This will lead him to investigate the subject more thoroughly, and perhaps to his advantage.

The same complaint can be made here as advanced in your editorial published December, 1888. "Identify the Quality of Contract Built Cars," wherein you refer to the "Knavish Peddler's Razors," and I judge "Another Car Builder" has had some malleable made by some inexperienced maker, that perhaps was not made for service, only to sell. Malleable.

Malleable Iron and Steel.

Editor National Car and Locomotive Builder:

In reply to "Malleable's" article in the January issue of the National Car and Locomotive Builder, I wish to ask "Malleable," whereby and by what mathematics, tensile strength, or elongation, does he prove that in eight years' service malleable iron is 75 per cent. cheaper than steel, and that no testimony can be brought to show that malleable couplers break, bend, or wear out only by collision. If those assertions are true, why are the railway companies as a rule getting disgusted with the vertical plane hook couplers now in service? Is it because they won't wear out, or is it because "Malleable" can't substantiate the argument he sets forth? There are several reasons why malleable iron will not do for M. C. B. couplers. First, because it is too soft, and accompanied by flaws perceptible only when a breakage occurs which exposes them. Secondly, because it is a material that requires a uniform pattern to get the best results and when so constructed is of no value in strength for the M. C. B. type or it must be increased in weight. From the absolute facts that if an M. C. B. coupler be constructed with proper proportioned lugs and ribs which will anneal properly with the rear portion of the bar, the head or mouth of the bars including the pivot lugs will be found weak and not capable of standing the shocks or pulling strain to which they are subjected. On the other hand, if these parts are strengthened, then the rear portion of the bar must be over an-

nealed to properly anneal the head of the coupler, hence the rear portion of the coupler will be of no value. In fact taking into consideration the difficulties thus encountered, the writer would prefer a well constructed cast-iron bar, so far as the M. C. B. coupler is concerned; but would prefer malleable for the common link type because in the latter a uniformity can be resorted to which is the sole foundation of the service in that class of couplers.

Observations strictly confined to the M. C. B. couplers point to the use of steel, *i. e.*, steel knuckles and bars, or steel knuckle with cast bar, which will prove of better service than that attained by malleable iron, and which will depend some on the make and style of the coupler. The majority of the M. C. B. couplers now in the field cannot last long, even made of the malleable that does not break or wear out. And those that will stand will give as good service with cast bars and steel knuckles, as that attained by the pin and link couplers.

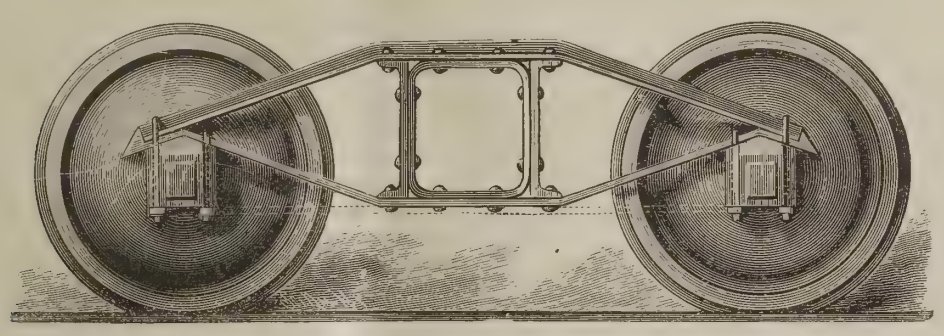
There is much that could be said about the M. C. B. coupler and its manufacture. One of the difficulties to overcome is the complication in molding it. To use iron that shrinks excessively is to encounter flaws; to make it in parts and bolt them together is to weaken it; to make them of material which requires no annealing, or which does not prove detrimental to the casting from light or heavy parts when annealed, is the only way out and the cheapest way round. MECHANICAL EXPERT.

[We do not think that this subject can be pursued further with interest to our readers, so the discussion will now be stopped.—ED.]

The Standard Truck.

Editor National Car and Locomotive Builder:

Take any type of bridge truss and it will not be found safe to limit its length c. to c. of end pins to the distance in clear between its pier copings. This is just what is done in the common diamond truck side trusses. Take out the tie bar at the bottom, arch it up at the center several inches higher than the bottom of axle boxes, or bend the pedestal bolts, and the axle boxes will tip towards each other under heavy loads. Two bars 3 inches by 1 inch overlying each other are but half as stiff as one bar



3 inches by 2 inches. This is the section that the two truss chords make as they come together at inner edge of axle box. The arch bar illustrated will do full duty on proper axle boxes without a tie bar, without pedestal bolts. Without reaction cushions, pedestal bolts will be essential, but, they need not be large. A light tie bar may be used, but in this case it can be arched up at middle to suit a minimum depth arch bar.

There is plenty of room for wider chords to the side trusses; for side trusses intersecting right over the axle centers, as sketched, take Carnegie's No. 36 channel 7″×2″ for top chord, and plain bar 7″×$\frac{9}{16}$″ for bottom one. Make effective depth of truss at middle 9 inches. wheel base 6 feet; place light cross beams 8 inches deep, 6 inches wide, parallel, and 2 feet apart c. to c.; interpose $\frac{5}{8}$″ lateral brace plates between ends of cross beams and side truss chords to gain the necessary depth for trusses at the middle, and also to give more room for rivets to keep the frame square. There is no room for cross bracing the frame between the cross beams and wheels on a short base truck, hence the need of wide chords, wide cross beams, and in keeping the cross beams a fair distance apart.

There is no patent on cold riveting; we do not believe in upsets or in hot riveting—it will not do where the vibration is sufficient to shake heads off. If possible to countersink both plates, the rivets can be made with coned heads; the point, just long enough to reach flush when the plates are clamped tight together, can be expanded by a center punch and light sledge to work against a sufficiently inert anvil under the head of the rivet. This fills the holes.

Patent reissue 10,289, belonging to ourself, is in the market as a New Year's gift, *for a small consideration*, based on the miles of single track or number of cars any road has.

Any road or railway club that makes the first satisfactory test of my arch bar can command me for pointers on how to make the body bolster rigid; how to make the swing bolster stiff enough to work well; how to traverse trucks without straining them, and how to make the present car floor stiffer and stronger, free.

ED. B. MEATYARD.

Against Rapid Painting.

In this month's issue an article published gives the policy of the Richmond & Danville Railway, of the rapid process of their cars going through the paint shop, which cannot be a profitable or a durable process.

The schedule by which the work is done, particularly the varnishing part, says: Thursday, trim and varnish, rub varnish (experience speaks for itself that varnish cannot be rubbed in so short a time); Friday, hair off and finishing varnish; Saturday, same; next day car ready for service. That would be thirteen hours between the first and last coat of finishing varnish.

It seems such a process would cause the paint and varnish to crack badly in three or four months, so car could not be varnished again except to burn all paint off.

If the time is limited to six days to paint a coach, give one coat rub and one coat finishing varnish; that would give more time to dry, and in eight or ten months car can be run in paint shop and be revarnished again, which would keep car out of service about four days and good for eight months longer, and at the end of three years they will find that the car will cost less to be kept in good shape and linger in paint shop less than with the rapid process of putting on one coat after another in such rapid succession. JAMES MERSEN,

Foreman Painter Minneapolis & St. Louis Railway.

MINNEAPOLIS, Feb. 14, 1889.

Comparison of a Pulley and a Locomotive Crank.

"An Inquisitive Locomotive Fireman" writes us:

"If a pencil was attached to the center of a crank pin of a locomotive driving wheel, and the locomotive placed alongside of a large drawing board, so that the pencil would register the movement of the pin, what form of line would be made in running the engine?" In investigating the question, other questions, of which I cannot satisfy myself as to the solution, arose. One of which was, considering the apparent difference in motion of rolling and revolving wheels, whether any fixed center of motion would apply in both cases? While a revolving wheel, such as a shaft pulley, is continually moving about one point—the axle—it seems to follow that this must be taken as the center of the wheel's motion. In the case of a rolling wheel, such as a locomotive driving wheel, there appears to be two motions—a revolving and a linear motion. While the wheel revolves, as before, around the axle, the line followed by any fixed point on the wheel seems to dispel the idea that the center of the axle can be taken as the fixed center of motion, for while any fixed point of the pulley wheel travels in a continuous circle about the center of its axle, a point on the driving wheel, such as a crank pin, travels in a curved line, the length of which, for each revolution, is equal to the circumference of the wheel, and which moves above and below the path of the center of the axle, a distance equal to that of the fixed point from the center of the axle. The path of the fixed point of the pulley wheel is always an equal distance from the fixed center of its axle, while the path of the fixed point on the driving wheel crosses and recrosses that of the center of its axle at each revolution. The peculiarity of this motion leads to conflicting ideas. If you consider the question worthy of your time, will you please give us some enlightenment in the March number of the NATIONAL CAR AND LOCOMOTIVE BUILDER?

[ANSWER.—It appears to us that a great deal of unfruitful investigation and speculation have been devoted to the effect which the motion of translation has upon the operating machinery of locomotives. So far as the application of power is concerned, the motion of a locomotive works in the same way when the engine is moving through space as it would do if the machine was jacked up, and the power transmitted through belts placed on the periphery of the driving wheels. And the driving axle would be the center of the path of the crank-pin just as truly in one case as in the other. And the center of the driving axle is as certainly the fixed center of motion as the center of a pulley.—EDITOR.]

Attitude of the Michigan Railroad Commissioner to Car Heating by Steam.

Mr. W. C. Ransom, Deputy Commissioner of Railroads of the State of Michigan, writes us saying that we were mistaken in the statement made in our last issue to the effect that the Railroad Commissioner of Michigan had published a circular taking grounds against the use of steam for car heating. Mr. Ransom sends us the only circular issued by the Commissioner, which reads as follows:

To General Managers and Superintendents operating railroads in Michigan:

Your attention is respectfully called to the provisions of Act No. 118 of the Laws of 1887, entitled "An Act to provide better protection of the lives of passengers and employés on railroad trains," a copy of which is enclosed.

You are also respectfully requested to state what, if any, action has been taken towards complying with the law which goes into effect November 1st next.

What has your experience during the present winter shown in regard to so-called safety heaters? Have you made any attempt to heat cars with steam taken from the locomotive; if so, what has been the result? Will your company have its cars equipped in accordance with the law when the law goes into effect; if so, what kind of heater will you use? If not to be equipped, why not?

An early reply to the above questions is most respectfully solicited, together with such other information as you may be able to give upon the question of heating and lighting passenger cars.

Also, what, if any, experience have you had with power brakes on freight trains; in your opinion are they practicable, and should railroad companies be required to use them as soon as their cars can be equipped with them without delaying the business of the roads?

What kind of automatic couplers do you use? What kind of automatic couplers is the best? Do you approve the Master Car Builders' type? Should all railroads be required to use the in order to secure uniformity at an early day?

We took the statement which Mr. Ransom refers to from a Western paper, and had no reason to doubt its correctness. We regret that injustice has been done, and willingly make the *amende honorable.*

Southern Consolidation Locomotives.

Railroad men traveling in the South can scarcely fail to be struck with the handsome appearance of the consolidation locomotives to be seen handling heavy freight trains on many Southern railroads. A close inspection of the engines on the different roads will inform the observer that they are strangely uniform in proportions and design. During a recent Southern trip a master mechanic of a leading railroad put the question to the writer: "Don't you recognize the original of the engine?" We could observe a strong family likeness to something we were familiar with, but it was only after he gave the key that we identified the consolidation locomotive of the East Tennessee, Virginia & Georgia, the Richmond & Danville and other roads as that designed by Mr. Charles Blackwell, for the Norfolk & Western, and fully illustrated in the *Railroad Gazette* in 1885. We could perceive that a few minor changes had been made, but it is still the same finely proportioned engine. The engine has proved thoroughly adapted for the work to be done or it would not have been so generally adopted as a standard, and the recognized merit of the machine forms a disinterested tribute to the ability of the designer. We were very much pleased to accidentally stumble upon this testimony as to the influence which Mr. Blackwell had exercised on a standard Southern locomotive, for he is such a retiring sort of a gentleman that the information would not be got from himself readily. Besides being an excellent designer, Mr. Blackwell is an able organizer and shop manager, which enables him to carry on the work of a railroad company to the best advantage. Many of our Southern master mechanics who are a little inclined to be proud of whatever distinguished is to be found in their own section are disposed to boast that the designer of their fine consolidation locomotive is now the mechanical head of a Southern railroad.

A correspondent writes us: "What is the relative value of a locomotive form of boiler with other forms for stationary engine purposes, where a steam pressure of 80 pounds has to be carried? Answer.—A boiler of the locomotive type has only one fault. It is not so easily cleaned out as some other forms of boilers. If the feed water is fairly free from the impurities that deposit scale, a locomotive boiler is rather better for supplying steam of high pressure to a small engine, than any other kind of boiler.

Some time ago a superintendent of motive power of one of the Pennsylvania proprietary roads who interested himself in making the best possible record in the economical operating of his department concluded that steel axles were not so valuable as they were reputed to be by the parent tree, so he made some very careful tests of the journal wear of iron and steel axles doing the same kind of service. The journal wear per 50,000 miles was found to be practically the same for the axles of both material. As the iron axle is considerably less in first cost it was the cheaper of the two. An old iron axle is generally regarded as more reliable than an old steel axle.

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EDITORIAL ANNOUNCEMENTS.

Advertisements.—*Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING COLUMNS. *The editorial department will contain our own views and opinions; and the rest of the reading matter, aside from advertisements, will be such as we consider of interest to our readers.*

Contributions.—*Articles relating to railway rolling stock construction and management, and kindred topics, by those who are practically acquainted with these subjects, are especially desired. Also early notices of changes in railroad officers, organizations and names of companies.*

Special Notice.—*As the* CAR AND LOCOMOTIVE BUILDER *is printed and ready for mailing on the last day of the month, advertisements, correspondence, etc., intended for insertion, must be received not later than the 25th day of each month.*

Defending Our Standard Unit of Measurement.

In another page we publish a most exhaustive and interesting paper on the Metric System of Measurements, by Mr. George M. Bond, manager of the gauge department of the Pratt & Whitney Company's Works, Hartford, Conn. Mr. Bond is one of the best living authorities on standards of measurement, and his views are certain to have great influence with master car-builders. His services in designing and superintending the construction of compartors or "measuring machines," which accurately reproduced and sub-divided the British standard yard, which is the basis of our standard measurements, brought him world-wide reputation for knowledge of systems of measurement and for skill in designing instruments of precision. That work was undertaken through the request made by the Master Car Builders' Association to the Pratt & Whitney Company to furnish standard United States screw thread gauges, and the unit then established controls the measurements in every railroad shop in America. It was a notable triumph for the cause of uniformity when the United States standard screw threads were made standard for all railroad work, and the interchangeability of parts that resulted from the agreement has saved railroad companies millions of dollars by reducing cost of repairs and in the preventing of delays to cars. The movement of the New England Railroad Club to induce the Master Car Builders' Association to adopt the metric system of measurement is equivalent to a proposal for the railroad companies to abandon the advantages they have gained from a convenient interchangeable system, and go through years of confusion of mixed measures to reach a standard which the best authorities on shop measurement say is not nearly so well adapted for shop dimensions as that with the inch unit. It will be noted that Mr. Bond exposes the fallacies and sophistries of the speakers who were most zealous in advocating the adoption of the metric system at the New England Railroad Club meeting, and he demonstrates that the system is admitted to be more inconvenient than the measurements by the inch unit in the shops where the former is used.

We have already alluded to the positive stand taken against the metric system by Dr. Coleman Sellers. When Dr. Sellers and Mr. George M. Bond put themselves on record as enthusiastic advocates of our existing system of measurements, practical railroad men are likely to heed their counsel in preference to that of schoolmen and cranks, who understand nothing about the difficulties of changing standards in machine shops.

William Sellers & Co. and the Pratt & Whitney Company have been leaders in the cause of bringing about uniform measurements and the production of interchangeable parts in machinery, and the views of their representatives are entitled to the highest consideration. Mr. Bond is a mechanical engineer who has given the cheap and accurate reproduction of standard forms special study for years, and he is better able to decide the best system of measurement for railroad shops than any mechanic or railroad officer who has not gone thoroughly into the subject. Dr. Coleman Sellers, so many years chief engineer for William Sellers & Co., was long brought into intimate contact with measurements based on the inch unit and others by the metric system carried on in the same works in Philadelphia. When the firm began making the Giffard injector, which was a French invention, they introduced the metric measurements along with it, and would have extended the system to the whole manufacturing establishment had they found it convenient. They still use the system in the department where it was first tried, and that department has grown to a vast extent. They now say that its use is fixed in that department by reason of the number of special small tools made on this system of metrology. The use of the metric system was not even legal at the time they took it up, and they acted with others to have the metric system made legal in order that its use might be adopted if the people found it to their advantage to do so. They opposed its being made obligatory because they had found that it was not nearly so practical as the American metrology. They distinguish the American from the English in this regard. The English stick to the old ton and its division into hundredweights and quarters, they weigh people by the stone, and so forth. In America the scales are graduated to hundreds of pounds, not to hundredweights, and the English nomenclature of tons and hundredweights is almost unknown here. In America everything has tended towards simplification, to classification, to interchangeability.

In a recent lecture at the Stevens Institute, Dr. Sellers, from his chair of engineering practice, called attention of the class to the American system of shop sizes, showing them that a well-considered shop system of sizes was of the greatest importance on the score of economy. He showed how the inch from its accidental length lent itself to a good system, if divided naturally. He said that the shop sizes of most common use could be expressed concisely thus: drills, taps, reamers, gauges, etc., advanced by sixteenths of an an inch up to one inch; by one-eighth of an inch up to two inches, and by quarters of an inch up to three, and then above that by half inches. He called attention to the fact that the makers of twist drills in Germany made them advancing by one millimeter in diameter to 400 mm., but they published the list with some sizes marked in bold-faced type, and these they say are the sizes used in their own shop as their shop sizes. These so-called shop sizes, if translated into our inch, are the sizes nearest to our sizes, advancing by eighths and quarters, but they advance by two and by three, now two, now three, but in no regular order. They have no system that can be concisely expressed. The are obliged to memorize the whole series. The reason of this is manifest. A decimal system is not a natural one and will not bear binary division, and continual halving is the want of nature. By the eye one can divide into two, into three, but not into five or ten. Let any one who does not know this try the experiment.

Dr. Coleman Sellers writes from the plane of the practical mechanic, and yet he is a school man, too. He is the advocate of system at any cost, and we know that had the metric system been worth introducing into general practice he would have been foremost in the work. His having written against its introduction comes from his having found it wanting. No one can read his papers on the subject without being convinced that he has had good reasons to offer against its introduction. We hope he may yet be heard from in these pages.

Reports of Mechanical Association Committees.

In another page of this paper will be found four circulars issued by the Secretary of the Railway Master Mechanics' Association, three of them containing the questions submitted by committees of investigation, the other announcing the time and place of next annual convention. We understand that objections have been raised to going to Niagara Falls, some parties being filled with regrets that both conventions are not going to be held at the same place. We would remind the people who are going round airing their views on this subject, that the decision as to the place of meeting was practically settled by the Association at last convention. Three places were chosen by the convention, at one of which the next meeting had to be held, and not one of them was the place chosen by the Committee of the Master Car Builders' Association as the place for holding their convention. While on the subject of places for holding conventions we would pause to remark that some persons outside of the associations are altogether too free with their interference in the business of deciding what place is best for the associations to go to. It would be much better to permit the members of the Association to manage their own affairs.

The circulars of inquiry issued are on subjects of much importance to railroad companies, and it is to be hoped the members will display their appreciation and sympathy for the work on hand by sending in all the information they are possessed of. We regret to learn that some members of committees have chosen to feel offended at remarks made at last convention about methods of making out reports of committees. An impression has been received that there were objections raised to the practice of collecting information by means of circulars. This is a mistake. In some lines of investigation the sending out of circulars is a waste of work; but in the ordinary run of investigations undertaken by the Master Mechanics' Association, the information most available is that supplied by the experience of the members, and the best way to collect that is by sending out circulars to be answered. The real objection raised was not to the collecting of information by circular, but to the crude, raw way in which the facts collected presented to the Association. Some of the reports presented at last convention were in merit and interest second to none ever submitted; but we also believe that the worst report ever presented is to be found in last year's proceedings. We repeat that collecting the answers to circulars and stringing them together *verb atim et literatim* is no way to make out a report. Good reports have the matter digested and the facts or practice summarized, so that the information given will be easily understood. The regular routine of their business requires that most master mechanics shall put information in digested form, and the practice ought to guide them in preparing reports for the Association. The head of every railroad mechanical department has to prepare periodically reports describing the condition of the machinery under his charge. He does not attempt to describe the work necessary on each engine to put it in first class order, but endeavors to convey an idea of the general condition of all the motive power without descending to individual details. If a report submitted to a general manager went on to enumerate the details of the work to be done on each engine, it would be read with considerable impatience, and the information conveyed would be small. Yet that has been the way some heads of committees have brought the information they had to give to the Association. Is it surprising that complaints have been made?

Stealing the Ideas of American Tool Makers.

Various forms of American machinery, particularly machine tools, have been for years rapidly gaining favor by users of such tools in foreign countries. Although the cost of production is higher here than in Europe, some of our first-class tool makers have been finding a steadily increasing market for their machine products in Great Britain and in different continental countries. American tool makers have devoted untiring attention and shrewd intelligence to perfecting the principal parts and the minutest details of their machines, so that the latter should be thoroughly adapted to the work they have to perform. Proper adaptability of means to the required end has been more intelligently studied among our tool makers than among their rivals abroad. The general use of the contract system has stimulated the developing of tools to perform the purpose of their design in the most perfect manner, and our practice of encouraging workmen to invent improvements in the tools they handle has given our tool makers the co-operation of a vast army of inventors, an important advantage enjoyed by the manufacturers of no other country. The result is that American tools are becoming popular abroad, even among a nation of tool makers, for the very convincing reason that it pays to use them.

British tool makers for years opposed the tendency of machine users to patronize American tools by abusing the articles made on this side of the Atlantic, or by sneering at what they called the silly fashion that favored Yankee notions. After a time it was found that abuse and unfounded detraction did not lessen the demand for American articles, so many respectable and enterprising British machinists began to take a lesson from their rivals, and a tendency became apparent among them to imitate American practices. Cut gears began to take the place of the noisy cast gears that were formerly universal, more attention was directed to building machines that would cut down material quickly and accurately, and some care was bestowed upon making the handling of tools convenient for the workman. The change was in the line of progress, and was a fair and legitimate method of meeting the inroads of competition.

All British tool-makers have not, however, confined themselves to respectable methods of competing with the merits of American tools. A firm of machinists and tool-makers in Hulme, Manchester, England, named John Holroyd & Co., have descended to the most disgraceful and dishonest ways that we ever heard of as a means of helping themselves to a share of the business of supplying to the European market tools of American design. This firm took the catalogues published to illustrate their tools by the Brown & Sharpe Manufacturing Company, Providence, R. I., by the Pratt & Whitney Company, Hartford, Conn., and by the Morse Twist Drill Company, New Bedford, Mass., and selecting the cuts of tools that were most popular in England, had them engraved exactly as they appeared in the catalogues from which they were stolen, formed the collection into a catalogue which they called their own, and sent it out with the announcement that it represented the tools they were making. The act is one of the most glaring frauds ever imposed upon buyers of any line of goods. If such a case were attempted in this country, it would be denounced in no measured terms by every respectable manufacturer. Englishmen pretend to be the special champions of "fair-play," but this is as foul play as could be readily conceived and the countrymen of John Holroyd & Co. display no disposition to intimate that the act does not meet with their hearty approval. The firms whose tool illustrations were copied united in a communication, addressed to the lead-

ing engineering and industrial journals in Great Britain, stating what had been done by John Holroyd & Co., and there was so little of the boasted fair play among these leaders of industrial intelligence, that not a single one of them would publish the exposure. John Holroyd & Co. can steal wood-cuts of first class American tools, but they cannot make tools like them, for it has been always well understood in machinery trades, that firms which could not design first class tools could not make them properly when entrusted with the designs of others. Any rogue can steal a first class mechanic's tools, but only a skillful man can use them. The fraudulent act of Holroyd & Co. disgraces all their aiders and abettors, and the disreputable imposition upon buyers ought to be denounced by all respectable journals.

The Demand for a New Standard Axle.

One of the most important actions ever performed by the Master Car Builders' Association was the establishing of a standard axle for cars. It is sixteen years since this was done, and in the meantime freight car loads have gone on steadily increasing in weight, till now there is nearly as much necessity for the selecting of a new standard axle calculated to carry cars of 60,000 pounds capacity, as there was for agreeing upon the dimensions of the axle selected in 1873. When that standard was settled upon, many really progressive railroad men thought the axle was too heavy for any load that ever would be made permissible in ordinary freight cars, yet within a very few years it was found too light for loads that became common. When the existing standard axle was established, railroad men had not come fully to realize the revolution in transportation service that the Bessemer steel rail was destined to bring about. They selected an axle that was too small to safely meet an unexpected increase in car loads, and many engineers well able to judge insist that within its present length the axle cannot be made suitable for carrying the loads that are coming. If this is admitted as correct, it would be the course of wisdom, when a new standard is inevitable, to establish dimensions which could be made to carry any practicable increase of car loads by merely making the diameter greater.

During the last two years, since a new standard axle was proposed officially, the various railroad clubs have freely discussed the requirements of an axle to carry a 60,000-pound car, and a very pronounced desire has been manifested to favor a new standard that would be of the same length between centers of journals as the present standard axle. An axle with a collarless journal has also received a great deal of advocacy, and heavy axles of this form used with the Johann oil-box, and with a box designed by Mr. W. H. Thomas, of the East Tennessee, Virginia & Georgia, are said to be doing good service under a limited number of cars. To judge from expressions of master car builders at club meetings, and at the last Master Car Builders' Convention, a reader would readily infer that opinion was almost unanimously in favor of an axle 6 feet 3 inches between centers; but when we examine the list of cars that have been built with axles capable of carrying heavy cars, we find that a large majority of the axles are made 7 feet 2 inches long and 6 feet 4¼ inches between centers. Opinions of railroad men as expressed at club and association meetings too often fail to express the intentions of the men who give the final decision about designs. The axle recommended at the convention of 1877 as being suitable for cars of 60,000 pounds capacity had nothing publicly said in its favor, and we have yet to hear the first speaker say anything commending the dimensions recommended. Yet when that axle went to letter ballot it received 397 votes in favor and 253 votes against. At the different club meetings, and at the convention of 1888, the axle, 6 feet 11¼ inches long and 6 feet 3 inches between centers, which was proposed as a standard, or an axle of similar dimensions, was highly commended by speakers; but when it was submitted to a letter ballot it received only 224 votes, while 307 votes were cast against it. At the last meeting of the Western Railway Club the axle for a 60,000 pound car was again very ably discussed, and with practical unanimity the speakers favored the axle which received so little support from the voting authorities.

The question most urgently waiting for settlement by railroad mechanical men to-day, is the agreeing upon a new standard axle, and every day that the settlement is put off is leading railroad companies into a condition that will in the near future cause great confusion, delay and unnecessary expense. When the Master Car Builders' Association meets next June, the members ought to come together prepared to make sacrifices of personal preferences in order to promote a basis of agreement. In hopes that we might help members to comprehend the existing condition of affairs clearly, we wrote to all the leading railroad companies asking for dimensions of the axles they are using under cars of 60,000 pounds capacity, and pages 36 and 37 of this issue contain the dimensions of practically all the heavy axles in use. It will be seen that an axle with the leading dimensions of that proposed in 1887 is in use on five of the largest car-owning roads in the Association, roads which last year had the right to vote on 142,578 cars. An axle approaching the dimensions of that voted on in 1888 is in use on six roads having a voting power of 92,598; but only two of the companies voted in favor of the axle. However desirable it may be to retain the distance of 6 feet 3 inches between centers of a new standard axle, it looks as if the advocates of this proportion cannot agree upon minor details, and that is likely to render the minority hopelessly weak. The majority of the arguments are in favor of the axle that can be worn down under light cars; but the majority of voters that have chosen an axle have chosen a long one, and in the end votes rule in the Master Car Builders' Association.

Bogus Dangers of Safety Car Heating.

At railroad club meetings and in conversations with railroad men, there has lately been manifested a disposition among the advocates of car heating by steam to raise doubts about the safety of hot water pipes in case of accident, and among those interested in hot water systems to caution the public against the danger from scalding by steam should anything happen to rupture the pipes in a car heated by steam. The parties who indulge in this kind of talk may be perfectly honest but we very much doubt their wisdom, and at all events they are permitting their interests to warp their judgment. There are a great many railroad managers who display a warm affection for the car stove, and if any plausible apology can be devised for retaining that relic of railroad barbarism, it is going to maintain its ascendency as a car heater. We know of no better way for supplying arguments in favor of the stove than the charges made by those interested in safety heaters, that the principle recommended by a rival is dangerous.

Heating with hot water is no novelty. It has been done for years in hundreds of cars, and there is no case on record of persons being scalded to death by hot water from the heater pipes when a collision happened. Heating cars with steam has not been so long or extensively practised among us as heating with water, but steam engineers are perfectly familiar with the action of escaping steam, and no engineer of any standing will make the assertion that there is danger of passengers getting scalded by escaping steam in case of accident, for he must be aware that no such danger exists. The experiment made before the railroad commissioners of Massachusetts, where a valve inside of a car belonging to the Old Colony was opened to permit steam freely to escape at 80 pounds pressure from a pipe 1½ inch diameter, was interesting to the general public; but no engineer familiar with steam matters needed that demonstration to prove that a ruptured steam pipe would do little harm. The men who go around prating about the dangerous nature of steam or hot water as a medium for heating cars, make themselves ridiculous in the eyes of those who understand the subject, and contemptible in the eyes of those who are ready to offer the evidence of the would-be experts on car heating as testimony against everything except the stove.

In the course of a private letter to the editor of this paper Dr Coleman Sellers, referring to the stand we have taken in regard to the introduction of the metric system into railroad shops, says: "I have read with interest what you have said in your editorial, and must say that you have handled the subject with a master hand. I am more than pleased with the force of your arguments. There are two ways of treating the subject—one fighting it, the other letting it alone. It is simply out of the question now to attempt to induce railroads to make a change from the existing metrology. That is fixed by the money value of the investment in mechanical appliances. Many years ago, I pointed out the fact that our scientific books alone written in a familiar language, had no equivalent in the French system. Since then no such books have been published simply because there was no demand for them."

We have received from Mr. Mr. H. Kingsland a long letter defending the existing unit of measurement as viewed from a shop man's standpoint. He expatiates on the confusion, expense and annoyance that would result from introducing the metric system into machine shops, and asks, as many others have done, where would any benefit come in from making the change? Our correspondent must really try us with an easier question. We have studied the subject considerably, but we have failed to perceive a single advantage that would result from the introduction of the metric system into our machine shops.

There are a great many mechanical and electrical engineers connected with the various Westinghouse companies in Pittsburgh, and they have lately organized themselves into a society for mutual aid and encouragement in studying subjects connected with their profession. Mr. L. W. Robinson, of the Westinghouse Electric Company, has been elected president.

The Georgia Central are in the market for 800 freight cars and a number of locomotives.

Literary Notes.

Development of Transportation Systems in the United States. With illustrations of hundreds of typical objects by J. L. Ringwalt, editor of the *Railway World*, Philadelphia. Published by the author.

This work is made up from a series of articles that have been appearing in the pages of the *Railway World* for several years. It is a very handsome volume of 400 pages 7 × 11 inches. In the preface the author says: "It is the object of this work to explain leading characteristics of the successive steps by which the canoe has been supplanted by the steamer, the trail by the T rail, the pack horse by the locomotive, and to furnish a comprehensive compendium of instructive transportation literature accumulated while railway mileage was expanding to its present huge dimensions." The purpose expressed is fully realized in the book. Beginning with Indian methods of transportation the various steps forward are very industriously traced and the appliances used at different periods described and illustrated. The book is arranged in four divisions named: Before Railways, Railway Infancy, Railway Youth, and Railway Manhood. In the first division all kinds of primitive methods of transportation are dilated on and their discomforts portrayed. The second division deals with early railway projects and experiments, descriptions of the crude methods of operating railroads for twenty years after steam locomotion on rails was first tried. Next division treats of the development of our railroad system, and the last division relates to railroad matters as they are now found.

We can scarcely conceive of any class of railroad men who would not find reading in this book that is both interesting and instructive. It ought certainly to be in the library of every railroad man who collects books for reading or reference. The one defect of the book is the illustrations, which are nearly all inferior engraving.

Our Railroads. Being a presentation of facts and figures, showing the value, earnings, profits and present condition of the railroads of Minnesota and the Northwest. By Harry P. Robinson.

This is a pamphlet published by the editor of the *Northwestern Railroader*, who has been noted for the vigorous, logical and successful conflict he has waged against the anti-railroad demagogues of the Northwest, who have for years been earning cheap political notoriety by their subversive attacks on railroad property. The title clearly indicates the score of the pamphlet, and readers will find that it contains a well digested display of facts and figures which prove that railroad property in the Northwest has brought smaller returns than any other form of investment. It is shown that the return on capital invested in railroads in the United States is only 3.40 per cent., as compared with 4.08 per cent. in Great Britain, where the capitalization per mile is four times as great. Compared with this comparatively low average capitalization on the railroad property in the United States, the money invested in the railroads of Minnesota and other Northwestern States is still lower, yet the earnings on the capital stock are less than the average. The teaching of the pamphlet is that Minnesota and the Northwestern States and Territories have got an excellent system of railroads without any outlay on the part of the people receiving the greatest benefit, and that they have never paid a fair return on the investment. The pamphlet is calculated to do a great deal of good, and it ought to be freely circulated in all the Granger States.

About Advertising and Printing. A concise, practical and original manual on the art of advertising. By Nathaniel C. Fowler, Jr.

This is a valuable book and gives a great deal of information that ought to be known by all advertisers. Those who solicit advertisements and arrange them will also receive valuable suggestions from the book. It covers a wide field. The subjects treated are: Generally, What?; Newspapers, Circulation and Rates, Writing, Puffs, Outdoor Printing, Type, Engraving, Novel, Quotation, Holiday, Window Dressing and Store Decoration, Samples, Technics. Many advertisers appear to follow no intelligent or systematic plan of operations. They insert a certain number of advertisements with little judgment as to the class of people reached by the medium through which the money is expended. A close study of this book, which is evidently written by a master of the art of advertising, would, we are sure, enable many of the firms that believe in using printer's ink as a means of obtaining customers, to spend their money to greater advantage. The book is published by L. Barta & Co., Boston. Price, $2.

Twenty Years with the Indicator. Being a practical text book for the engineer or the student. By Thomas Pray, Jr. Published by John Wiley & Sons, New York.

Readers of mechanical literature do not need an introduction to the author of this work, for the articles which comprise the book have long made him well known to the men most likely to be interested in this line of steam engineering. Mr. Pray has had long experience as a mechanical engineer devoted to lines of investigation which required the use of the steam engine indicator. He began using this useful instrument when its value and utility were little recognized, and the

book contains the leading lessons of his experience. It covers a wide range of steam engineering practice. All the elementary instruction necessary to enable a novice to apply the indicator is given, and the leading forms of indicators are described and the purpose of the various attachments explained. Then follows a series of "lessons" illustrating the information that the indicator diagram imparts to the steam user and inquiring engineer. The incidents of most of the lessons are drawn from experience and are highly interesting reading. Not only the student, but engineers perfectly familiar with indicator practice, will find instructive, interesting and often amusing reading in "Twenty Years with The Indicator."

We have received the complete first volume of the *Locomotive Engineer*, edited by Mr. John A. Hill and devoted to the special interests of locomotive engineers and firemen and to locomotive maintenance and repairs. The twelve numbers comprising the first year's work make up a highly interesting volume that reflects the greatest credit upon the publishers and the able editor. While containing many exhaustive articles on the subjects treated, the leading feature of the *Locomotive Engineer* is about bright, spicy articles that strike the salient points of a subject and very frequently flash scintillations of wit upon it. Brother Hill has stamped his own personality upon the paper.

When Mr. Robert J. Burdette was collecting items for the *Burlington Hawkeye* he was greatly given to drawing inspiration from the edifying talk to be heard in engine houses and about railroad employés' waiting rooms. He was first moved to essay a poetical flight by the disaster to a stray cow in her encounter with the B., C. R. & N. switch engine "Louise," and the pathetic lyric produced is still sung to the music of the freight car's roll by many an Iowa brakeman. Under these circumstances we considered it appropriate to send a copy of Sinclair's pamphlet on Combustion in Locomotive Fire-Boxes to Mr. Burdette. We have received the following acknowledgment:

"BRYN MAWR, Pa., Feb. 4.

"DEAR MR. SINCLAIR: 'Combustion in Locomotive Fire-Boxes' just received. Many thanks. I am going to read it to my man and see if he can't learn to make a three-story furnace heat a two-story house.

"ROBERT J. BURDETTE."

"Hemenway on the Steam Engine Indicator," published by John Wiley & Sons, New York, is used as a text book in the Stevens Institute of Technology and in several other technological schools. We feel assured that more can be learned about steam engineering by the study of this little book than from any work ever published.

We have received the Report of the Proceedings of the Twenty-second Annual Convention of the Master Car Builders' Association. The report is got out in the usual style, and forms a volume of 222 pages, with a number of folding sheets in addition containing the illustrations.

Personal.

Mr. J. N. Lauder, superintendent of motive power of the Old Colony Railroad, is enjoying a holiday trip to California and the City of Mexico.

General W. D. Washburn, president of the Minneapolis, St. Paul & Sault Ste. Marie Railroad, has been elected United States Senator for Minnesota.

Mr. E. Haines, formerly master mechanic of the Pittsburgh & Lake Erie road, died at his home at McKee's Rocks, Pa., Jan. 22. He had been in failing health for two years.

The Michigan Legislature has elected as member of the United States Senate Mr. James McMillan, president of the Duluth, South Shore & Atlantic, and of the Michigan Car Company, Detroit.

Arthur M. Waitt has resigned his position of assistant master car builder of Boston & Maine Railroad to accept a position of importance in the service of the Pullman Palace Car Company, on March 1.

Col. Frank S. Parrott, of Bridgeport, Conn., one of the principal partners in the Parrott Varnish Company, died very suddenly last month. Col. Parrott was an aid on the staff of Governor Bulkeley, and was a very influential man, respected by a large number of friends.

Col. Geo. W. Howard has resigned the position of superintendent of the Colorado Midland to become the chief officer of the Brotherhood of Railway Conductors, a new but apparently very vigorous organization lately formed in the West. Col. Howard was said to have been a very energetic and popular railroad officer.

We were mistaken last month in making the announcement that Mr. Clem. Hackney had accepted the position of head of the mechanical department of the Missouri Pacific. Mr. Hackney is living at 624 Washington street, Milwaukee, Wis. Considerable pressure has been put upon him to accept a position in private business, but he intends to return to railroad work.

The promotion of Mr. John S. Lentz to be superintendent of the car department of the Lehigh Valley Railroad raises upwards one of the ablest master car builders in the country. The fine condition of the car equipment of the Lehigh Valley, which is apparent to every observer, has for years been a substantial monument to the efficiency of Mr. Lentz. Few men in their rising fortune have the good wishes of a greater number of warm friends than that enjoyed by the new superintendent of the car department of the Lehigh Valley Railroad.

The Big Four Mechanical Department.

It would be a difficult matter to find railroad shops in which more work is turned out than in those of the Cincinnati, Indianapolis, St. Louis & Chicago, at Cincinnati, O. Built some thirty years since with a capacity calculated for forty engines, these shops are to-day keeping up eighty-two engines, and are doing this so effectually that of the eighty-two engines eighty are in service.

Were it not for a most efficient adaptation of the piece-work and interchangeable systems, with the many local aids, this work could not be accomplished in such illy arranged shops. We find but ten lathes, three planers, two drill presses, a shaper and turret bolt machine as the equipment of tools.

Although the larger part of this company's engines are fifteen years old their condition is so good that with 45 freight engines 2,700 cars are daily handled.

To Master Mechanic Jno. S. Patterson is due the credit for the first-class condition of this road's equipment. Mr. Patterson is one of the modern master mechanics who keep in the front rank, as is evidenced by the details of his work. Making no pretense to maintaining an expensive test department, still all material is tested thoroughly and scientifically. All oil is tested for gravity, flashing point, congealing point and comparative life in service. All iron boiler steel, paint, etc., etc., is thoroughly tested.

The value of such tests is unquestioned, as was demonstrated practically to the writer. A lot of oil, guaranteed to have a flashing point of 300 degrees, was being tested; it gave but 263 degrees.

The blacksmith shop is specially fitted up for furnishing large quantities of work for both locomotive, car and road departments. All scrap is here selected, piled, shingled and drawn into axles, etc. All wrought iron work pertaining to cars is made by one blow of the steam hammer or special forming machines. In fact, this shop has few if any equals in this specialty. The writer has seen many car link formers, etc., but here is found the simplest and most expeditious in the writer's knowledge. One blow of a steam hammer forms the bar into a U, while the second blow finishes completely a perfect link. In this shop is made all bolts for car work, all track bolts—of which as high as 8,000 have been turned out in a day.

The passenger equipment of this road is noted for its elegance, and was designed and built by Mr. Patterson. Eighty men all told are employed in the car department. A baggage car and passenger coach, with the regular monthly output of 20 freight cars, are now under way. This shop, on a pinch, is capable of very expeditious work, having turned out three baggage cars complete in 30 days and three parlor cars in 10 weeks.

A department of which Mr. Patterson speaks very highly is the plating and cleaning department. Here all car trimmings are re-plated, car seats cleaned and re-dyed.

The performance-sheet shows remarkable results in the way of economy, and more so when it embodies in "other M. P. accounts" salaries of all motive power officers and clerks, water stations, insurance and all expenses pertaining to this department. Coal costs $1.55 per ton.

The items are:

Oil and waste	.0016
Fuel	.0488
Repairs	.0250
Engineer and fireman	.0545
Wipers and hostlers	.0041
Other M. P. accounts	.0136
Total	.1476

St. Louis & San Francisco Shops.

The St. Louis & San Francisco railroad shops at Springfield, Mo., are being remodeled under the direction of Mr. J. R. Groves general master mechanic of the road. The old shops have been too small and very inconvenient; but when the changes now going on are completed they will have as good facilities for doing work economically as any shops west of St. Louis. Several new buildings have been erected and large transfer tables put in. There is an entirely new boiler shop, and car shop, and additions have been put to the machine shop. The boiler shop is 185×90 feet, and the car shop is 256 × 90 feet with a wing 150 × 65 feet. The boiler shop is arranged with pits, so that it may be turned into an engine erecting shop when the future growth of the establishment calls for that. The blacksmith shop is without smoke-jacks, the hood stack of each fire leading to a large horizontal pipe overhead running the entire length of the shop. One end of this pipe is coupled to an exhaust fan which delivers the smoke into a stack. This keeps the shop always clear of smoke, and is the most effectual means of ventilating a blacksmith shop we have ever seen tried. We commend an examination of this arrangement to every railroad officer contemplating the building or improvement of a blacksmith shop.

The car shops are furnished with the best tools in the market, and they will have sufficient capacity for keeping in repair all the cars belonging to the road. The planing-mill has an overhead line shaft, which would have been placed beneath the floor, but for the swampy condition of the soil, making it dfficult to keep out water. The arrangement of the machinery is such that no unnecessary handling of the material is called for. The pieces of lumber are kept moving forward till finished. The boilers used were designed by Mr. Kearney, master mechanic in charge of the shops, and they have a downward draft, the fire resting on water grates and delivering the gases of combustion downwards. An inferior grade of coal is used, and the construction of the fire-box enables the fuel to be burned with entire absence of smoke. Mr. Groves speaks very highly about the economical features of this boiler.

The arrangement is to run the machinery in each shop by a Westinghouse engine, making the power of each shop self-contained.

There is in Mr. Groves' office a peculiar form of engine record designed by himself. There are three painted lines representing the railroad. The middle line is black, and represents the track, the upper line is white and represents "good order," and the lower line is blue and indicates "bad order." All divisions are marked off separately. Pegs are provided on the top and bottom lines for carrying checks which have particulars about the dimensions, etc., of each engine. This enables the master mechanic to see at a glance what engines are on each division, their dimensions and condition.

The Cincinnati, Hamilton & Dayton have awarded a contract to the Litchfield Car Company to build 200 box cars.

Snow Flangers.

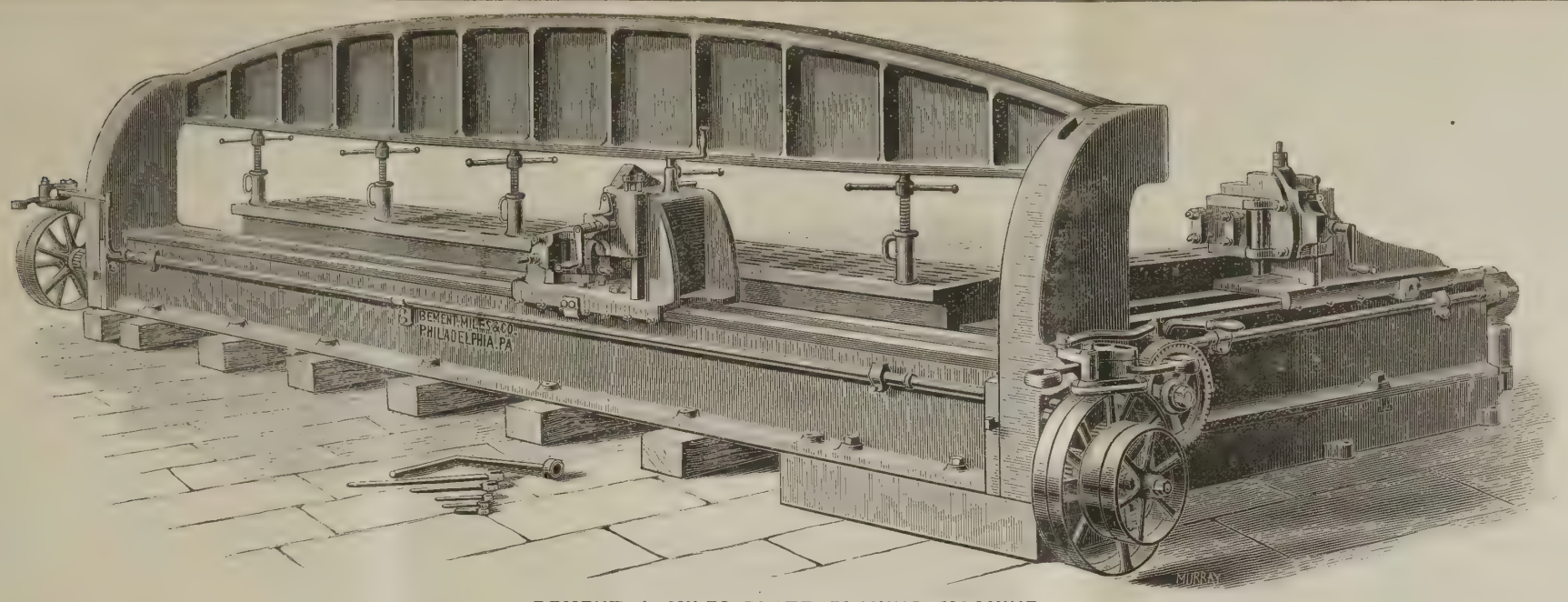
At the February meeting of the Northwestern Railroad Club Mr. Matt. Ellis, Chicago, St. Paul, Minneapolis & Omaha, read a paper tracing the development of the snow flanger and showing the cost of operating one of the most efficient flanger cars. The paper concluded: There is no comparison to be made between a road well equipped with appliances for keeping the flanges clean and one depending on hand labor to do this work. On the road with which I am connected, we have ten flangers ready for service, distributed at the different engine houses all over the line and can easily flange the 1,400 miles of road in less than ten hours. During the past eight years it has been our practice to run from twenty-eight to thirty-five wedge plows on our way freight and other freight trains every day during the winter season. This winter the practice has been discontinued as being unnecessary up to this date. Our snow plows are arranged so that they can be raised by screws and they are run with the points raised when the snow is not troublesome. Should a snow or wind storm arise when the engine is in the freight service, the train is side-tracked and plow dropped and track cleaned of snow. It is customary to run a flanger immediately following the snow plow. This engine attached to the flanger is then available as a "drag-out engine" in case the snow plow should require assistance. The equipment which I have described has proved entirely adequate for removing snow and keeping the road open except in the case of unusual storms and in places very much exposed to the severe drifting winds of our prairies. These conditions we hope to meet by the use of the rotary plow which I have no doubt will do the effective work which is claimed for it, and solve one of the problems which have puzzled our railway managements for many years.

The following paper by Mr. W. T. Reed, Chicago, St. Paul & Kansas City was read:

The flanger is a machine which is worthy of attention, and which, if properly arranged, can do good work, or in other words leave a clear flange, which lessens the liability of damage to the machinery of the engine, makes less chance of the engine leaving the track, enables more cars to be hauled and better time to be made, causes a saving in fuel, and saving in damage to track. All rotary and wedge-shaped plows should be fitted with a flanger and wire brooms, so as to leave a clean rail for the engine to pass over. In the northwest country, where at times the temperature is low, occasional blizzards fill up the flanges with sand and snow, and have caused the derailing of engines, and destruction to life and property, where, if the flanger had been brought into service, the chances were that the engine would have kept the rail, and an accident been prevented.

Some railroad companies use the flanger car only, others the engine flanger, which goes to prove that different companies have different ideas, and no doubt it would be a hard matter to establish a standard. I would suggest as follows:

1. That flanger be located in front of engines and attached to pilots in such a manner that they can be easily repaired.
2. That the knives or cutters be made out of second-hand spring steel, with the cutting edge tapered, and set slightly forward, and secured to the frame of the flanger in section and bolted, so that should the section next or inside of rail get broken, it can be easily removed, and replaced by another section; the engineer to carry a supply.
3. I would recommend the Temple or Priest flanger. One is worked from a fixed point near point of pilot, with slot in the same to allow for curves. The other raises and lowers bodily, and will take more snow from the centre of track, but is less adjustable on curves.
4. I would recommend flanges to be raised and lowered by air, and should the air give out provision should be made so that the flanger will still raise.
4. The flanger should be provided with a span or chute, for the purpose of accepting the snow for same, and on such an angle that will throw snow from track.
6. All passenger engines on roads troubled with snow should use a flanger, which can be so constructed as to take the place of the pilot plow.
7. Should flanger cars be used, I would recommend the Ellis or Goulette pattern. One is hung from the centre of a box car, and worked by air or lever. The other is hung at both ends of the car so that flanging can be done running either way, and so save the reversing of the same on table. The raising and lowering can be done by air, and worked by engineer.

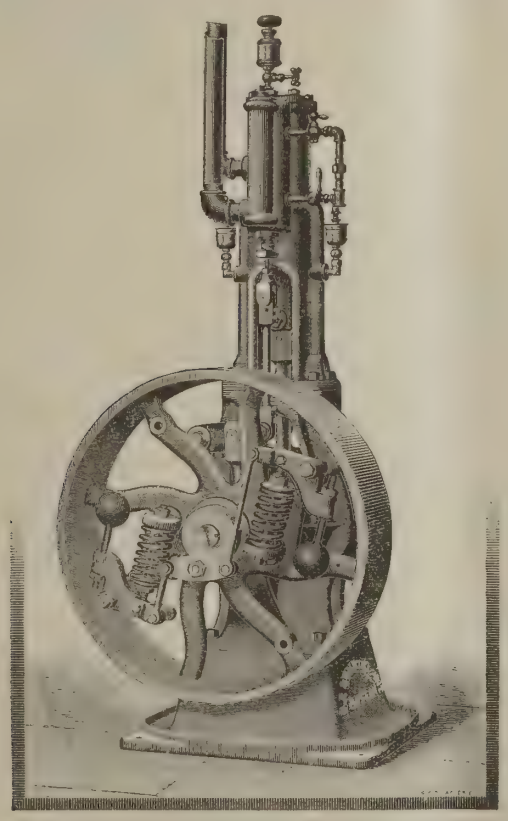


BEMENT & MILES PLATE PLANING MACHINE.

The engraving represents a machine designed to plane two edges of a plate up to 30 feet in length by 10 feet in width at one setting, or any length by shifting. The advantage of such an arrangement is manifest, for it not only admits of finishing the entire plate at two settings, but it saves room, for with the usual type of machine, which cuts but one edge at a time, the plate has to be set transversely as well as parallel to the bed, requiring a space in both directions equal to its greatest length. The planer has sufficient power to work 1-inch steel plates with ease, and is therefore serviceable for heavy marine boilers and ship-plating. The carriage on the longer bed has two tool slides facing eac other and cutting in reverse directions, one of them having a vertical slide with a swivel for cutting a strip off the edge of a sheet and for planing internal angles. The transverse bed is arranged to swivel on a base plate by means of a pinion and circular rack, giving a variation of ten degrees in either direction from a right angle. As its carriage has much less to do than the other, it has but one tool slide, cutting in one direction, with a quick return motion. The clamping bar is bolted to the uprights, and the plates are held in position by hand screw jacks which can be quickly placed and removed. Owing to the space between the clamping bar and the table, the machine can be used for planing beams, keels and a variety of other work. Each carriage has an independent driving gear, operated by two belts for the forward and backward movements, separately shifted.

The builders of the above machine are Bement, Miles & Co., Philadelphia, Pa.

Below we illustrate in perspective a very useful and economical form of small upright automatic engine, which ought to be preferred to the steam-wasting slide-valve engines so much used for small powers. As will be seen, this engine is very compact, and the parts are of easy access. The valve is of the balanced piston type, accurately ground to a fit, and provided with an ingenious contrivance whereby all damage from water in the cylinder is avoided. The governor consists of two weights secured to arms with a revolving pulley, co-operating by



Sturtevant Automatic Upright Engine.

their centrifugal force to compress two long and powerful springs, and acting on the eccentric. The admission of steam is regulated by changes in the travel of the valve, effected by the movement of the eccentric across the shaft. The point of cut-off is thus variable, according to the load, from zero to seven-eighths of the stroke, and an exceedingly economical distribution of the steam is secured. The governor wheel, owing to its weight, serves as a balance wheel, and may be utilized as a band wheel. The opposite end of the shaft is splined to receive an additional wheel, if desired. The direction of rotation of the engine may be easily changed by transferring to the empty holes in the arms of the governor the studs which carry the weights and levers, and at the same time reversing the position of the weights, levers and springs.

The engine is built by B. F. Sturtevant, Boston, Mass.

Mr. Walter D. Gregory, recently chemist of the N. Y., L. E. & W. R. R., has accepted a position with Messrs. Chas. H. Gillespie & Sons, varnish manufacturers, New York.

The New Albany Forge Co., New Albany, Ind., have erected a large building, covering about half an acre of ground, for the purpose of manufacturing bar and merchant iron. They are also busy in their axle department, having several large orders on hand.

The Acme Machine Company, Cleveland, O., are making for the Minnesota Car Company, W. Duluth, Minn., six bolt cutting machines, four double and two single. They report a rapidly increasing demand for these machines, so much so that they will have to build in the spring an additional shop, doubling their capacity.

Hendricks Brothers, 49 Cliff street, New York, the well-known dealers in copper, tin, spelter and other metals, report business to be very active in their line. Railroad men who have once used copper sheets, wire rivets and other products supplied by this firm invariably speak well of the satisfactory quality of the goods.

The Ohio Falls Car Company, Jeffersonville, Ind., has under construction, for sale, the following rolling stock: 2 coaches finished with mahogany and beveled mirrors, suitable for chair cars; 4 same as above, finished with mahogany and veneered panels; 6 elegant first-class coaches, finished in antique oak; 2 32-ft. caboose cars; 100 34-ft. 20-ton flat cars; 50 34-ft. 20-ton gondola cars; 50 34-ft. 20-ton box cars; 50 34-ft. 20-ton stock cars. All ready for delivery within 30 days.

In the Pullman shops most of the labor on cars is done by contract. The workmen put on the Winslow asphalt roof for 25 cents less than they do the work on a double board roof.

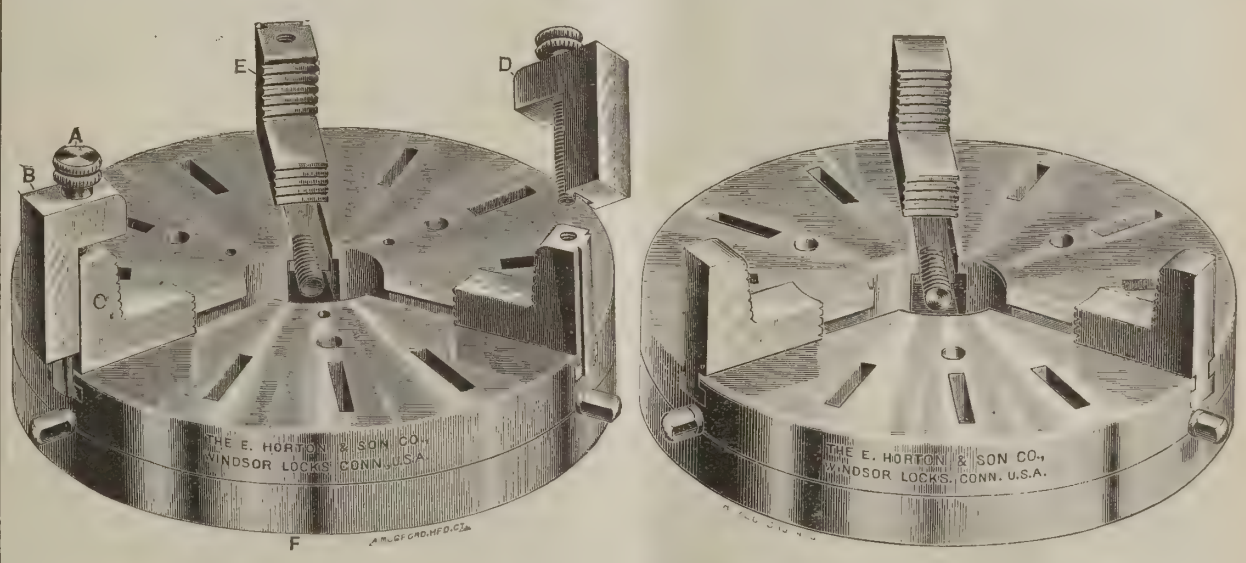
The chief office of the Iron Car Company has been moved from 115 Broadway to the Equitable Building, 120 Broadway, New York. Mr. G. W. Ettinger is now general manager of the company.

The Zimmerman and the American Refrigerator Car Companies are applying the Winslow asphalt roof to their cars, because they find that it is a better non-conductor of heat than the best board roofs.

Merchant & Co., Philadelphia, Pa., have published a little book giving facts relating to the iridium anti-friction metal, which they manufacture. Interesting information is given relating to metal for bearings, and the results of tests made by severa engineering experts are published. Those interested in using good bearings will find valuable facts in this small pamphlet.

There is quite a demand for the universal radial drills made by the Universal Radial Drill Co., Cincinnati, O., they having quite a number of orders on hand for them. Among them were two for the United States Government, to be sent to the Washington Navy Yard; one goes to the Whitlock Machine Co., Birmingham, Conn.; one to Coatesville, Pa., and another to Kansas City, and one to the Geo. Gray Machine Tool Co., etc., etc.

At the eighth annual meeting of the stockholders of the Burton Stock Car Company, held at Portland, Me., Feb. 12, 1889, the following officers were elected: President, Joseph C. Moore; Vice-President, Charles A. Sinclair; Treasurer, Charles Howard; Clerk, Clarence Hale; Assistant Clerk, Joseph W. Fellows; Directors, Joseph C. Moore, Edward Spalding, Ezra H. Winchester, Virgil C. Gilman, Frank Jones, Charles F. Adams, J. Oak Davidson, George D. Burton, Charles A. Sinclair. William S. Reed, James P. Cook. Murray V. Livingston and Charles Howard.



HORTON CHUCKS FOR 42-INCH CAR WHEELS.

The cuts herewith represent a new 42-inch car wheel chuck (for which patents are pending), designed by Mr. E. B. Bailey, who is the General Manager of the E. Horton & Son Co., Windsor Locks, Conn. The peculiarity and main difference between this and their regular car wheel chuck is its increased strength, the manner of inserting the jaws into the shell, and the clamp jaws *B*, as shown in No. 1, the object of which is to hold the wheel or tire (more particularly the latter) more firmly in the grip of the permanent jaws *C*. As will be seen, the bite of the latter are made to fit the tread of wheel or tire, and in working upon them they have a tendency to pull out of the grip of chuck jaws; the clamp jaws obviate this difficulty.

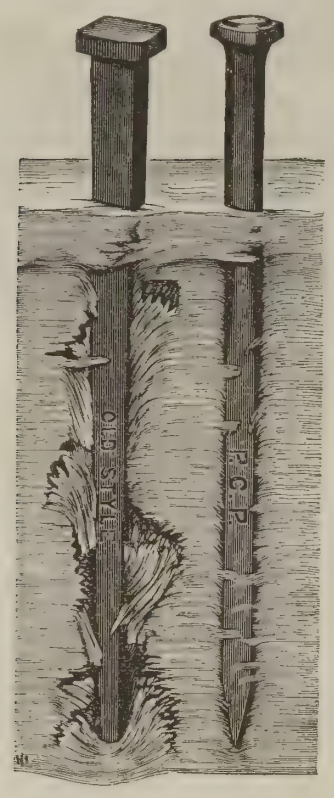
These chucks are self-centering and are attached to the lathe or boring mill, generally by means of a face plate, turned off perfectly true, to fit the seat for that purpose in back of chucks, which, if properly done, will insure the chuck to run true and to hold a wheel or tire perfectly true while being bored or turned. By the use of these chucks much time is saved in adjusting work and accuracy is insured.

The faces of the jaws are true with face of chuck, and the bite of permanent jaws is made at an angle of 3 degrees unless otherwise ordered, so as to correspond with the shape of the flange and tread of wheel.

This chuck can be furnished without the clamp-jaws, as shown in cut No. 2, if wanted, and it then makes a very superior Universal chuck for holding car wheels on to a boring mill. When made with jaws with steps, or common jaws, for general lathe work, it makes the strongest and largest Universal chuck for a lathe in existence. The company mentioned will soon have these chucks ready for market, and it goes without saying that they will be first-class in every particular, as the quality of their work is well known.

Calumet Chisel-Pointed Nails.

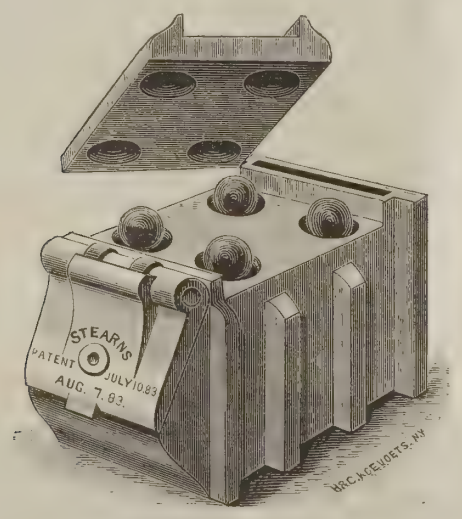
The annexed engraving illustrates the manner in which the Calumet parallel sided, chisel-pointed steel nail enters the wood which it is used and alongside is the old style nail as found driven. The illustrations were made from an actual test which was photographed. After examining the manner in which the two kinds of nails embedded themselves into the wood it is not surprising to find that the Calumet nail shows from 30 to 75 per cent. more holding power than the old one. The chisel point



passes through the wood by cutting, separating and deflecting the fibers slightly downwards and pressing them compactly beside the nail so that it is very firmly held in its place. Besides holding better, this form of nail is not so liable to split the wood as the old form is. This nail is manufactured by the Calumet Iron and Steel Company, Chicago.

Stearns' Flexible Car Axle Box.

The annexed engraving shows the Stearns flexible car axle box which has been in use for several years, and has proved of great advantage in preventing the irregular wear of wheels. The peculiarity about the box is so plainly seen in the cut that little description is necessary. Four hardened steel bulls set in chilled pockets intervene between the box and the weight resting upon it, and provide a flexible medium, which permits the axle to



roll freely forward without being lurched by the movement of the truck. Much of the angular movement of the wheel that leads to the cutting of the flanges is thus prevented. The box is handled by the American Railway Equipment Company, New York.

Carrying Fruit in Refrigerator Cars.

A consignment of oranges from California was recently received in New York in excellent order, the fruit having been transported in Tiffany refrigerator cars, which are successfully used, not only for keeping cargoes cool, but also for maintaining a temperature above freezing. A New York paper referring to the matter says: "The oranges are a brand known as 'Sunnyside,' and are entirely seedless. They were shipped by B. B. Barney, of Riverside, San Bernardino County, Cal., to Chicago in the course of a regular shipment to that market, and were then forwarded to New York by express. When the boxes were opened the oranges were found to be in perfect condition right through the boxes, not a single sign of decay being visible. The plan was conceived by Mr. Pierce, of Chicago, who represents a number of capitalists interested in the subject of fruit transportation. The plan of preparing the fruit for shipment is a secret, but Mr. Pierce claims that by it he can guarantee the arrival of the fruit in as good a condition as it was shipped. The fruit is prepared for shipment in a warehouse, and then is shipped on refrigerator cars especially prepared for the purpose, and the fruit can be carried any distance within any reasonable time without damage.

Mr. Pierce further stated that the plan proved very successful last season, 125 car-loads having been shipped from Southern California to Chicago and the Northwest, and orders had been given for building 200 additional refrigerator cars to be run over the Atchison, Topeka & Santa Fe system.

On being asked whether it was the intention of the company to introduce California oranges on the Eastern markets in large quantities, Mr. Pierce replied that the high railroad rates seemed to him an obstacle to a very profitable business in that direction, and he declared further that his object in bringing the fruit on to New York was to demonstrate to the dealers in and growers of Florida oranges that the process could be applied to Florida oranges as effectually as to California. "The work has been done," he said, "as a preliminary measure to introducing the system into the South, to let the growers see that there is no necessity for their receiving only $1 per box for their fruit on account of the decay."

The E. D. Albro Company, of Cincinnati, Ohio, are very busy on some large orders for mahogany for several of the large railway passenger car builders.

During the past year they have imported and sawed into veneers a large number of English brown oak logs, the wood now so much in demand.

Some stocks of veneers now in the company's warehouse of English oak display remarkable figure and size. They have also a large and very choice stock of San Domingo mahogany veneers. Business is very good with them.

The De-oxidized Metal Company, of Bridgeport, Conn., have recently cast a bell made of their metal that weighs 3,400 pounds for the Fairfield County, Conn., Court House. Some of our readers will doubtless remember the small bell they had on exhibition at the Master Mechanics' Convention at the Thousand Islands, and which some of the members said could be heard two miles on the river. If the large bell just made will make as much noise in proportion to that made by the small one, the citizens of Bridgeport will not have occasion to complain that they could not hear it.

The Long & Allstatter Co., Hamilton, O., are building a steam driven machine for punching holes in splice bars, etc., that will punch six holes at a time. This machine, being steam driven, will punch through the heaviest steel bars. They are also building a multiple punching and welding machine which is growing in popularity, as it saves a great deal of labor, punching and finishing as many as a hundred holes of different sizes at one operation. They are meeting with great success with their welding machines for welding all shapes of bar iron, it being only necessary to heat the material to be welded to the proper heat, place it in the machine, and in two seconds the work is completed.

We have received an illustrated catalogue of the electro-plating and polishing material and machinery made by Hanson, Van Winkle & Co., Newark, N. J. This company manufactures all the apparatus, and supplies all the material necessary for establishing and operating electro-plating plant required for doing the work connected with any car shop. They intimate that they are prepared to make estimates for outfits, and to give practical instructions for carrying on the works. Heads of mechanical departments that think of introducing the use of an electro-plating plant would do well to look into the apparatus that Hanson, Van Winkle & Co. have to offer.

We commend our readers, who have to use or put in use hand saws, to try the merits of the B. M. T., manufactured by the Montague-Woodrough Saw Co., Chicago. The writer met the inventor of this saw in the office of Mr. Sanborn, general superintendent of the Chicago & Northwestern Railway, about a year ago, and was invited to witness some practical tests of the aggressive nature of this saw when it had a fair opportunity to slide through a heavy wooden plank, and the conclusion reached, after a fair exertion of muscle on a common saw and one of the B. M. T. type, was that with a given amount of energy the latter saw would see the bottom of a plank in about half the time taken by the former. For a household saw, where it generally takes about one thousand horse-power of pushing and cussing to do a calf power of work, we think the new saw is destined to effect a moral reform such as never was approached by the most suggestive appeals of eloquent preachers.

Messrs. Pedrick & Ayer, Philadelphia, have published a neatly illustrated catalogue showing their milling machines, and explaining the advantage of using this class of tools in machine shops. It says: Very few mechanics understand to what extent Universal milling machines may be advantageously used in general shop practice. The prevailing idea is that these machines are intended solely for tool-room purposes, and to a certain extent it is correct, on account of the weak construction and narrow limit to which they are confined. Strong and powerful machines, calculated for general use in railway and machine shops, alongside of heavy machines, have rarely been considered, and none have endeavored to produce a machine of sufficient strength and apacity as to warrant such use; this is particularly so as regards railway machine and repair shops. Noting this fact, and knowing that much work can be done to better advantage, with greater precision, and with a saving surprising to those who have given little or no thought to the Universal milling machine, we have arranged with the inventor of the machine illustrated and described in this book for its introduction to the railway and general trade.

Milling cutters and tools need not be necessarily expensive. Many do not purchase the Universal milling machine because of the expense of the cutters, and the mistaken idea that the time gained in doing work on the Universal milling machine is more than off-set by making and sharpening tools. This is not the case. For removing metal on faces, edging up work, etc., the Butt mill is decidedly preferable. This style of cuttter costs less to make, will do more work, is easier kept in order, and will do truer work, even if not ground proper, than any other kind. Another kind of tool for small work, is the Shank mill; it is quickly made, easily kept in order, and will last a long time. Still another kind of tool can be made by making a shank to fit into the taper hole in the spindle, with a thread on end, on which can be screwed different sizes and shapes of cutters, angle cutters, etc., all of which are used on the principle of the Butt mill cutter. On some kind of work the saw cutter can only be used, like curved work or surfaces that have several different shapes.

The Currey Manufacturing Company, Chicago, are meeting with success in grinding colors on special orders for use in large shops. Their equipment both in mills and workmen are especially adapted for fine grinding. They have orders for special gear colors, special body colors, special primers, etc., and it is their purpose to extend this feature of the business. Samples of any desired color can be sent to them and they will be matched and furnished at lowest prices, and the best work and materials only will be employed.

We have pleasure in directing the attention of car builders and others to Spurr's natural wood veneers and carvings for interior decorations. The woods of which the veneers are formed are prepared in thin sheets, and are backed with a preparation which renders them impervious to heat or dampness. They are placed directly upon plastered walls and ceilings, and by the use of wood moldings are laid out in panels, dado, frieze, center pieces, etc., in as simple or elaborate designs as may be desired These, in connection with our new patent natural wood carvings, give all the effect and richness of elegant cabinet work and hand carving in the fine and rare woods, such as mahogany, satinwood, Circassian walnut, French walnut burl, Hungarian ash, amaranth, bird's-eye maple, figured American walnut, and many others. Those who have used these veneers bear cordial testimony as to their beauty, durability and economy. They are very finely adapted for the inside decoration of cars.

At a visit to the shops of Messrs. Fay & Co., builders of wood working machinery, Cincinnati, O., the writer found them busy as usual. Their shops are the largest in the United States, if not in the world, for that class of machinery. They are divided into ten different departments, covering a floor space of about four acres, and they employ about 300 men. They have recently shipped ten car-loads of wood-working machinery to Decatur, Ala., for the United States Rolling Stock Company, and more to follow. They have received the contract for the fitting up of their large car shops there. They are sending a large quantity of wood-working tools to the car shops at Anniston, Ala., and are busy on other orders. They are sending 25 different kinds of wood-working tools, finished in the very best manner, to the Paris Exposition, which opens in May next, none of them like the tools they exhibited there in 1886. It will be the largest display of wood-working machinery ever exhibited at an exposition. Mr. Doane and three experts will take charge of the exhibition. They will leave on the "Umbria" on the 13th April.

Messrs. Manning, Maxwell & Moore, 111 Liberty street, New York, write us: "As a matter of 'news items' we presume that you will be pleased to notice that Mr. T. W. Welsh, superintendent of the Westinghouse Air Brake Company, left here Saturday, having placed his order with us for 214 21-inch lathes for the new shops of the Westinghouse Air Brake Company, now being constructed. This is probably the largest order ever placed in this country for this class of machine tools, and we feel much gratified at the fortunate result of our competition, because of the very exacting requirements of the Westinghouse people for the highest standard of tools, and our securing the order entirely on the merits of our tools."

The order to supply the tools for the new shops under construction for the Kansas City, Fort Scott & Gulf, at Springfield, Mo., has been awarded to Manning, Maxwell & Moore. The order includes all machine shop tools, boiler shop tools, and all shafting, etc. Among the tools called for are driving wheel lathes, wheel presses, boring mills, radial drill, slotters, shapers, milling machines, and a large number of different sized lathes, from 42 inch swing down to 12 inches, planers from 60 × 60 inches to 26 × 26 inches. Also punch and shears, and large plate bending rolls.

Our Directory.

We note the following changes since our last issue. Our readers will do us a great favor by giving us prompt notice of any changes that may come to their knowledge or of any error that may be noticed in our list:

Lehigh Valley.—Mr. John S. Lentz has been promoted from master car builder to superintendent of the car department.

Los Angeles & Pacific.—R. C. Shaw, general manager, has been appointed traffic manager, and the duties of the general manager have been assumed by the president, E. E. Hall.

Northern Pacific.—M. C. Kimberly, superintendent of the St. Paul Division, has been appointed assistant general superintendent. Mr. S. R. Ainslie has been made general superintendent.

Chicago, Burlington & Northern.—Mr. J. R. Hastings has been appointed general superintendent in place of Mr. J. M. Barr, resigned.

Montana Union.—Mr. Robert Law is appointed superintendent, to succeed Mr. G. W. Dickinson, resigned.

New York Central & Hudson River.—Mr. C. D. McElvy has been appointed superintendent of division from New York to Spuyten Duyvel.

New York, Susquehanna & Western.—Mr. George W. Waite has been appointed superintendent in place of Mr. C. D. McKelvy.

Cumberland Valley.—R. H. Middleton, superintendent and manager of the Harrisburg & Potomac, has resigned.

Harrisburg & Potomac.—Harry Bomberger has been appointed superintendent, to succeed R. H. Middleton, resigned.

Burlington & Missouri River.—F. S. Granger has been appointed assistant superintendent of the Southern Division, with headquarters at Edgar, Neb.

Milwaukee, Lake Shore & Western.—Charles H. Hartley has been appointed superintendent of the Northern Division, with office at Ashland, Wis.

Suffolk & Carolina.—Charles H. Jones, Jr., has been appointed general manager of the company, with headquarters at Suffolk, Va.

St. Louis, Arkansas & Texas.—The office of the General Manager has been removed from Texarkana to St. Louis, Mo.

Louisville Southern.—W. H. Adams has been appointed Superintendent, vice A. J. Porter, resigned.

Union Pacific.—General Manager T. L. Kimball has issued a circular announcing the following changes and appointments: C. S. Mellen, having resigned the position of assistant general manager, has been appointed traffic manager, with headquarters at Omaha, Neb. E Dickinson has been appointed assistant general manager, in charge of the lines east of Cheyenne, with headquarters at Omaha.

NATIONAL CAR AND LOCOMOTIVE BUILDER

APRIL, 1889.

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Miscellaneous Items.

Osgood Bradley & Sons, of Worcester, Mass., are building several new cars for the Knox & Lincoln road.

The Pittsburgh Locomotive Works have completed three of the four engines recently ordered by the St. Louis, Vandalia & Terre Haute.

The Lehigh Valley Railroad has given an order for the construction of 100 cars at the Waverly shops, which have been idle for a year past.

The Elliott Car Company, of Gadsden, Ala., is building 38 fruit cars, 18 cabooses and 100 platform cars for the Alabama Great Southern road.

The Harlan & Hollingsworth Company, of Wilmington, Del., last week completed several new passenger cars for the Wilmington & Northern road.

The Ohio Falls Car Company has contracted with the Kentucky Midland Railway for the passenger and freight rolling stock with which to open the road.

The Central of New Jersey has under contract with the Harrisburg Car Manufacturing Company, 150 box cars, and with Pardee, Snyder & Co., Watsontown, Pa., 100 box cars.

The Reynolds & Henry Construction Company, which is building the Houston, Central Arkansas & Northern Railroad, is asking bids for platform cars and two locomotives.

One of the Strong locomotives has been running passenger trains on the New York, Lake Erie & Western for the last two months, and is reported to be doing the work efficiently and economically.

The United States Rolling Stock Company, of Anniston, Ala., has been awarded a contract for building 700 cars for the Central of Georgia. An order for building 350 coal cars for this road will also soon be let.

The "senatorial train" on the Baltimore & Ohio between New York & Washington, and the "congressional limited," on the Pennsylvania Railroad, are both fitted up with "Scarritt" parlor car chairs.

Recently the Tacoma mill, at Tacoma, W. T., sawed several sticks of timber 82 feet long, 23 by 24 inches square, and others 92 feet long and 22 by 22 inches square, for shipment to the London Exhibition.

The Middletown Car Works, of Middletown, Pa., have commenced the construction of 350 freight cars for the Philadelphia & Reading. The Dauphin Car Works are also constructing 150 freight cars for the same road.

The Oklahoma historical exhibition, which has been formed at Wichita, Kan., has contracted with the Burton Car Company to build a special train. The exhibition will leave Wichita, April 25, going direct to New York City.

The Louisville & Nashville recently received from the Rogers Locomotive Works two locomotives with 21 × 24 inch cylinders. The company is about to build four passenger engines at its own shops with 18 × 24 inch cylinders.

The Kansas City & Memphis Railway and Bridge Company is erecting a bridge across the Mississippi River at Memphis. The three caissons will require 1,500,000 feet of timber each, or 4,500,000 feet in all. Yellow pine or other timber will be used.

The Chicago & Northwestern people are experimenting with the Swain metallic piston-rod packing. This packing is a thin ring of an anti friction metal backed by a binder of rubber. It goes into an ordinary stuffing-box and can be applied cheaply.

The Seaboard & Roanoke has just completed 100 box cars at its own shops, equipped with the Janney coupler and automatic brakes. The Janney coupler will hereafter be used on all cars built for this road. The new shops at Portsmouth, Va., have also just been completed.

The South Baltimore Car Works have received an order from the Richmond & Danville Railroad for 750 freight cars. These cars will be built during the spring and summer, and with the orders now on hand and the others that are expected, the works will be kept running on full time.

The C., B. & Q. people are considering the advisability of abandoning the use of screws for fastening car roofs and adopting the use of nails. The argument brought against the use of screws is that they are always driven like a nail and that consequently they do not hold any better than a nail.

In Bavaria now all fast trains are equipped with the Westinghouse brake. The Heberlein brake, heretofore used, which requires the combined action of the conductor and a brakeman to apply it, will be used hereafter only on mail trains, where only government employés will be killed in case of accident.

The Denver & Rio Grande Western Railroad Company have placed with the North Chicago Rolling Mill an order for the first lot of heavy steel rails, in furtherance of a plan to widen their gauge and furnish a neutral connection from Colorado to Salt Lake City and Ogden free, on equal terms to all lines east and west of the Rocky Mountains, and of a uniform gauge with them.

According to the Cleveland *Leader* the young lady clerks in Mr. Ross Kell's office are so attractive that the head of the establishment has had to put into service a "matrimonial thermometer" to test young men seeking admittance to the office. We are inclined to think that our contemporary was a little previous in the announcement that the tester is in active service. It is merely needed.

The Reading Railroad managers have issued a circular forbidding the running of locomotives by firemen, and establishing a rule that all firemen shall, at the end of eighteen months' service, undergo an examination; if they pass it they will be placed in the line of promotion; but in case of failure they must serve another eighteen months before they can make application for a second examination.

The Webb compound locomotive has had several trials on the Pennsylvania Railroad within the past month, and is now in fair working order. She does not steam very freely and it is said that she will not handle nearly so heavy a train as that pulled with ease by the class K engines, which have cylinders 17 × 24 inches, and 66-inch wheel. The compound runs well, but is very slow in starting a train from a station.

Colonel Towne, general manager Southern Pacific, speaking of the operating expenses, said: "If we had cheap coal, we could show $5,000,000 more profit on our last year's statement. If the New York Central had to pay as much for coal as we pay it would bankrupt the company. The Southern Pacific obtains its coal from San Pedro and San Francisco at a cost of about $6 a ton, and distributes it over 5,000 miles of track, on which there is not a pound of native coal."

Among the persons killed in the accident at St. George on the Grand Trunk Railway on February 27, was Mr. E R. Baines, store keeper for the Grand Trunk Railway at London, Ont. Parties who attended the last M. C. B. convention held at Niagara Falls will remember Mr. Baines, owing to the active part he took in entertaining the company, and for the readings he gave in the drawing room. He is very highly spoken of by his associates for his pleasant, genial ways.

An accident happened lately in the Little Miami yards at Cincinnati which showed that there is nothing in the claim industriously worked up by interested parties to the effect that passengers are in danger of death from scalding in case of an accident happening that would rupture the pipes of a steam heated car. One passenger train was backed into the side of another train, and the side of a chair car crowded with passengers was smashed in almost to the aisle. The passengers were thrown in a heap and mixed up with broken steam pipes from which the steam escaped freely, but no one was scalded.

Master Mechanic Bushnell gave an interesting lecture last night to forty engineers and firemen in the B. of L. E. hall on "combustion." Angus Sinclair has been writing some interesting articles on this subject, which have been supplied in book form to all their firemen on the road by the B., C. R. & N. Company, and Mr. Bushnell is simplifying and explaining the subject to the engineers and firemen in a course of lectures which will continue for some time. Mr. Bushnell believes in efficient service and pursues the proper methods to attain it.—*Cedar Rapids Gazette.*

Says Professor Hadley: "The speed of railroad trains is restricted within three theoretical limits: First, a physical limit of 80 miles an hour, beyond which it is found impossible for a train to hold the track; second, an operating limit of 60 miles an hour, which practical experience has found trains cannot run without much damage to life; third, a commercial limit of 30 miles per hour, at which, all things considered, it is found most economical to run a train." All of which shows that Professor Hadley does not know so much about railroad matters as he professes to do.

A locomotive boiler recently exploded on the Cincinnati, Washington & Baltimore Railway. The train at the time was being pulled by a Rogers engine twenty-four years old, and was making about thirty miles an hour. The barrel was completely torn off from the wagon top to the smoke arch, the driving wheels were blocked by the wreckage, so they could not turn, but the engine, strange to say, did not leave the rails. There is nothing strange about a locomotive boiler twenty-four years old exploding; the wonderful thing is that so many worn-out shells hang so well together long years after they ought to be in the scrap heap.

A circular has been issued by the North American Railroad Superintendents' Association asking for information about the heating of cars. No less than sixty questions are asked in the circular, and it is supposed that the Association will be in first-class shape to discuss car-heating problems when the members have studied over the answers for a few months. It has been suggested that there are a great many things that come directly under the supervision of superintendents that are badly attended to, and that the attention of superintendents would be better employed looking after them than interfering with matters that belong to the mechanical department. We believe there is a big grain of truth in this.

The Street Railway Committee continued and concluded the hearing on the petition of W. B. Mack and others for incorporation as an elevated railway company. The witnesses were John Thompson, for 27 years superintendent of motive power on the Eastern Railroad; Orlando Stewart, superintendent of motive power on the Fitchburg Railroad; James K. Taylor, with 18 years' experience as master mechanic of the Old Colony and Boston & Lowell railroads, and other practical railroad men. They testified to the practicability and safety of the Mack system, and agreed in the opinion that the divided short axles of the Riley system were impracticable and that the cars could not be run with safety.

The Lake Shore & Michigan Southern are getting twenty-five new locomotives built at Schenectady. There are three eight-wheel passenger engines, fifteen moguls and seven six-wheel switchers. The passenger engines have cylinders 18 × 24 inches, wheels 66 inches and boiler 52 inches diameter at smallest ring. Steam of 180 pounds pressure will be carried on the boilers. Five of the moguls have cylinders 17 × 24 inches and ten of them have cylinders 19 × 24. The boilers are 58 inches diameter. The fire-boxes of all the engines except the switchers will be above the frames. The experience of the L. S. & M. S. officials with some engines they have in service having the larger grate area, due to the fire-box extending over the frames, inclines them to extend the practice. They show a material saving of coal over engines of the same general dimensions, but having the deep narrow fire-box.

Master Mechanics' Views on the Tire Question.

IN GENERAL.

Several months ago we addressed a circular letter to the leading master mechanics, asking for information respecting the relative wear of thick and thin tires, and inquiring in what way their record of tire wear was kept. We have received thirty-nine replies, mostly from the leading railroads, and covering companies that represent about 12,000 locomotives. Nearly all the master mechanics writing the letters express themselves as being deeeply interested in the subject, and it is very encouraging to find that the general practice is to keep a systematic record of tire wear from the day a tire goes into service until it passes to the scrap heap. A great many of the correspondents have sent us a leaf from the book containing their tire record, and the method of keeping the the latter shows great uniformity. Some of the forms call for greater elaboration of details than others. All show the number of engine, the time the tires went into service, the mileage made between each turning, and the time the tire was removed. Different methods of measuring tires are followed, some taking the thickness with common callipers, but there is a decided tendency toward employing an instrument of precision, such as the Mackenzie gauge, to make this measurement.

DIVERSITY OF VIEWS.

An analysis of the letters received proves that there is much greater diversity of opinion about the most economical thickness for a locomotive tire than we had supposed to be the case. Sixteen of our correspondents have had no experience with tires thicker than about 3 inches, and most of them are waiting for more light before they begin introducing thicker ones. Among the heads of mechanical departments holding this sentiment are: R. W. Wade, Richmond & Danville; F. D. Casanave, Pennsylvania lines west of Pittsburgh; L. B. Paxson, Philadelphia & Reading; W. T. Small, Northern Pacific; S. B. Haupt, Norfolk & Western; Ross Kells, New York, Lake Erie & Western; J. B. Henney, New York & New England; J. S. McCrum, Kansas City, Fort Scott & Gulf; Herbert Wallis, Grand Trunk; N. W. Semple, Denver & Rio Grande; I. G. Hutchins, Columbus & Hocking Valley; R. W. Bushnell, B., C. R. & N.; W. L. Hofecker, Central of New Jersey; E. B. Wall, Pittsburgh, Cincinnati & St. Louis; J. N. Barr, Chicago, Milwaukee & St. Paul, and W. C. Noble, Houston & Texas Central. Mr. Barr kindly sent us a table showing the tire records made by a great many of the engines under his charge, but it was impossible to form any definite conclusion from the information.

UNDECIDED AS TO THE BEST THICKNESS.

Nine of our correspondents are in doubt about what thickness of tire is most economical. This condition of uncertainty prevails to a great extent among those who give their decision in favor of thick or in favor of thin tires. There are so many influences that may be exerted to shorten the life of a tire, or to make one set last much shorter time than another set subjected to the same apparent conditions, that nearly all the officers in charge of motive power hesitate to come to a decision.

Mr. Amos Pilsbury, Maine Central, writes:

"Some two months ago you wrote me for information concerning the difference in wear of thick and thin tires. For some unaccountable reason your letter was laid aside, and has just been brought to my notice.

"For many years past it has been my custom to order tires of uniform thickness (3 inches) for all services, but during the last year I have departed from that rule, and have put on 3½ and and 4-inch tires.

"You will see by this that I am unable to give any satisfactory statement showing comparative difference in wear, and shall not be able to do so for some time to come. My impression is that we shall get better results from 3-inch than from 4-inch tires, and for this reason I am keeping a careful account of mileage."

Mr. W. J. Robertson, Central Vermont, writes:

"Two years ago I placed on an eight-wheel engine a set of Krupp's crucible tires, drive wheel 68 inches diameter, and after a service of 87,000 miles I have just had them turned, and from observation after the turning I could see no difference other than a tire that would be turned to 1½ inches; the texture was apparently the same."

T. B. Twombly, Chicago, Rock Island & Pacific, writes:

"I have only one engine that has worn out both a 3 and 4-inch tire in the same kind of service, and these tires were of different makes.

"This engine No. 81 is a switch engine with 34 tons on drivers and performing the most severe switching service on our road; that in the passenger yard.

"The results were as follows:

"Three-inch, brand A tire, 3,028 miles to $\frac{1}{16}$ inch wear; total miles run, 85,076.

"Four-inch, brand B, tire, 3,120 miles to $\frac{1}{16}$ inch wear; total miles run, 95,290.

"Our method of measuring tire wear is to keep a record of miles run between turnings, and the amount taken off tires at the turnings.

"The switch engine mileage is reckoned as so many miles per day, therefore the above mileage for engine 81 is in reality not mileage at all, but day's work. However, as one day is the same as another, the comparison would be just as valuable. I wish to say that results from one engine would not cause me to form an opinion as to merits of tires; I should want an average of many engines."

Mr James Meehan, Cincinnati, New Orleans & Texas Pacific, writes:

"I have had experience with 3, 3½ and 4-inch tires on locomotive drivers, and adopted 3-inch about a year ago as standard, more because our wheel centers, as a rule, were of such a diameter that 6 inches of tire gave the correct size of wheel for the cylinder. I used 4-inch tires a few years ago in the case of our 17 × 24 Baldwin passenger engines that appeared to be overcylindered; subsequently I added 1,100 lbs. to the foot-plate, and now they run satisfactorily with 3-inch tires.

"At that time this question of generic difference was not before the mechanical public, and I made no test or comparison. I have always thought that too little attention has been paid to the way engines were handled, and if in night or day service. My experience as an engineer has been that engines running mostly at night had a much worse rail to contend with than those running in day time, principally, and use more sand; also, we all know how an engine can give 50 per cent. better service in the hands of a good regular engineer than in cases where they are run first in and first out, and crews constantly changing.

"My method of keeping record of tire wear is simply by having the thickness reported on 'Historical Record' at each turning. I can get mileage at any time from mileage book, and my 'Historical Record' shows all particulars of engine when new, especially the make, brand and thickness of tires. The engine is allowed to run until tires need turning, at which time report is made of thickness, and, again, report of thickness when turned out of shop

"It would surprise me if experiments proved that a 4-inch gave less per $\frac{1}{16}$, than a 3-inch, out of same bloom, as I firmly believe the rolling friction on rail, under heavy weight, has a tendency to compress the fiber.

"My master car builder reported to me that some 42-inch Wednesbury wheels, under Mann cars, having made 25 per cent. better mileage after turning.

"If not foreign to this subject, I would say that we are in a fair way to get 50 per cent. more mileage out of tire here run in connection with my patent brake shoe than those previously run without, and particularly on consolidation engines that used to trouble me greatly with cut flanges, necessitating a loss on turning up to gain stock enough to fill the standard flange gauge."

Mr. John Hickey, Milwaukee, Lake Shore & Western, writes:

"For years past we have been using tire three inches thick, but since we have increased the weight of locomotives the tire wear per mile run has increased to an enormous degree. Locomotives having a total weight on drivers of about 43,000 lbs. or 10,750 lbs. per wheel, have shown an average mileage of 18,500 miles per $\frac{1}{16}$ inch wear, while locomotives engaged in similar service having tire of the same manufacture, but a total weight on drivers of 58,000 lbs. or a weight per wheel of 14,500 lbs. has rendered but an average of 11,800 miles to the same unit of wear; the steam pressure and cylinder capacity being about the same relative proportions to the adhesive weight, in both cases. The conditions conducive to the most rapid wear of tire are, weight, the practice of slipping, and careless use of sand, their power of destruction being relatively in the order in which they are named. When these combined elements are present in their worst features, the wear of tire becomes one of the most serious questions we have to meet. The expense of replacing the tire is not alone involved, but the interruption of business caused by the frequent removal of the locomotive from service, the increased number of locomotives necessary to perform a given amount of service, and the injurious effect of worn tire on frogs, switches and track, should also be considered. Our first efforts should be directed towards removing, or at least reducing, the cause of this rapid wear of tire. The most essential element to deal with is certainly the reduction of the weight per wheel, and this under present condition of traffic can only be obtained by increasing the number of wheels under the same total weight, reducing thereby the weight per wheel. The practice of slipping locomotives, especially when accompanied by a large amount of weight on drivers, is not only a rapid tire destroyer, but is destructive alike to machinery and fuel. The next in importance is the selection of a traction increaser having less tire destructive elements than sand. The introduction of jets of steam between the rail and all connected driving wheels; a mechanical contrivance whereby the weight on drivers can be increased or reduced to suit circumstances; or a combination of both would without doubt be a vast improvement on the present practice of sanding the rail. I have thus far departed from the main question namely, the relative merits of thick and thin tire, for the reason that I am convinced the points above stated regarding the wear of tire rank higher in importance, or deserve at least equal consideration with the question, 'Will tires 3½ and 4-inch thick render as many miles per unit of wear as those rolled to a thickness of but 3 inches?' In comparing the relative value of thick and thin tire, many points governing a true solution of the matter are often not considered. To the weight per wheel, the diameter of the same, the class of service engaged in and the relative proportions of steam pressure and cylinder capacity to the adhesive weight, should be added the amount of sand used per mile, the number of revolutions made between turnings, including the number of slipping revolutions, noting carefully the number of the latter in connection with the number of serviceable revolutions. In fact, the elements that must be taken into account, in order to determine truthfully the relative values of tire on different locomotives, are so numerous and so difficult to observe accurately, that the method is not a safe plan on which to base comparisons. I would suggest that there is but one way to arrive at the true wearing qualities of thick and thin tire, and that is to place 3½-inch or 4-inch tires on one side and 3-inch tires on the other side of the same engine. Arranging three or four locomotives engaged in different service in this manner will demonstrate clearly and without doubt, the relative wearing qualities of tire of different thickness. Pending the investigation we favor the use of tire not less than 3½ inches thick."

Mr. John Henney, New York, New Haven & Hartford, writes that he had been recently using tires 3½ inches thick, and he could not find any difference in their wearing quality compared to that of tires 2½ inches thick formerly used.

Mr. G. H. Prescott, Vandalia Line, informs us that he has not gone beyond 3⅝ inches in the thickness of driving-wheel tires. He sent us a statement showing the mileage made by certain engines, and some of it was unusually good, but no conclusion as to the relative wearing quality of different thickness could be deduced from the figures.

Mr. W. F. Turreff, Cleveland, Columbus, Cincinnati & Indianapolis, and Mr. Charles Blackwell, Central Georgia, gave no data.

FAVOR THIN TIRES.

Six of our correspondents favor the use of tires not rolled thicker than 3 inches. Mr. G. W. Rhodes, Chicago, Burlington & Quincy, had by carefully compiled records of tire wear concluded that 4-inch tires were not economical and on this account his company has determined to order no more tires of that thickness. The dataon which Mr. Rhodes based his conclusions have been published in these pages in the proceedings of the Western Railway Club.

Mr. Charles Graham, Delaware, Lackawanna & Western, did not find a perceptible difference in the wear of tires between 2½ and 3½ inches thick, but he expressed the belief that a 4-inch tire would be spongy.

Mr. L. H. Turner, Pittsburgh & Lake Erie, had a limited experience with 4-inch tires, and, according to his observations, they wore more rapidly than a thinner rolled tire.

Mr. Harvey Middleton, Louisville & Nashville, does not use any 4-inch tires, and he does not think that it pays to have tires rolled more than three inches thick, which is the standard with his company.

Mr. M. C. Wheeler, Central Iowa, mentions some experience he has had with 4-inch tires, and does not consider it warrants him in extending the use of thick tires, so he will not order any more thick tires. In a tire record he submitted, tires three inches thick are shown to have made about 14,000 to $\frac{1}{16}$ inch wear, while a set of tires four inches thick made only about 8,000 to the same loss of metal.

Mr. H: A. Whitney, Intercolonial, writes:

"I have had no experience to speak of with tires more than three inches thick.

"We had four engines last winter with tires four inches thick, and they have been running up to the present time. Their ties are now being turned, and I find that the time of day the engines run makes more difference in the wear of tires than whether they are thick or thin.

"Two of these engines, which I speak of, ran over the same district and with the same description of train. Both were in the hands of careful men, one running during the day and the other at night.

"The engine that ran at night wore her tires very much faster than the one that ran in day time. My impression is, however, that tires three inches thick will give more service per inch than a tire four inches in thickness, although I have no data to prove it."

Mr. John Player, Wisconsin Central, writes:

"Our experience has been that the first wear on tire usually gives the greatest mileage per $\frac{1}{16}$ inch reduction in diameter. Our records show this to be a fact, but not in all cases. Experience also shows that rapid wear of tire is not always due to the quality of metal of which the tire is composed. The wear of tire is due in a great measure to the way engineers handle the sand levers; also, the kind of sand used. I have noted that engines using sharp, fine sand, found on banks of streams, did not wear the tire nearly [so bad as engines using coarse sand screened from gravel. I have taken an engine using sand screened from gravel that had before turning worn her tire badly, and placed the same engine after her tires were turned on a division where we used river sand and obtained good mileage per $\frac{1}{16}$ wear. So marked was the reduction of wear on tire when using the fine sand, that the management of the road were induced to have sand for engine service 150 miles, in order to get the benefit of the fine sand on all divisions. Referring to the matters of thick versus thin tire, I have no data to prove anything, but my experience is in favor of thin tires. It was my misfortune once to have charge of a number of new engines that, when their tire had worn to need turning and been turned, the tire proved to be defective and pieces of various lengths, from 6 to 12 or 15 inches would crumble out of the flange. In order to get all possible wear out of those tires, special tires were ordered to mate with those remaining good. In other words, to replace tires found defective. These special tires were as an average about two inches thick, and in all cases gave excellent wear. So much better did they wear that it would cause the tire on opposite wheel to run to flange on account of smaller diameter, due to more rapid wear. To obviate this trouble special tires were placed on forward wheels, where they would get the first of the sand, and the old tires were worn out on the back wheels. The greatest amount of wear given by tires that were rolled thin was so obvious, that it is a question with me whether it would not pay to have tires rolled, say, two inches thick, wear them down to 1½ inches, and scrap them.

"The only feasible theory for experience above stated would seem to be that in the thin tire the metal is more dense, must of necessity be so, for the same pressure is brought to bear on the tire in rolling thick or thin. This, I think, could be tested by cutting a section from a thick and thin tire direct from the roll, and applying acid and taking an etching from the surface. It is a matter worthy of investigation, but we are not in position to make such a test."

IN FAVOR OF THICK TIRES.

Seven of our correspondents believe that it pays to roll tires 3½ inches thick or over. Under this head Mr. G. W. Stevens, Lake Shore & Michigan Southern, mentions that he has been using 4-inch tires under switching engines for the last two years, and he believes that the mileage made per unit of wear is just as good as it is in the case of thin tires.

Mr. W. T. Reed, Chicago, St. Paul & Kansas City, says that he is in favor of thick-rolled tires, and considers 4-inch tires more serviceable than those rolled 3 inches thick.

Mr. W. Wilson, Chicago & Alton, has used tires 3½ inches thick for twelve years and considers them more economical than thinner tires, as a greater proportion of the material can be used up before scrapping. Proceeds: "We have car wheel tire 3 inches thick, also 2¼ and 2½ inches thick when new. Tire 3 inches thick are Krupp and put on wheels made here. Balance are open Hearth tire, which we get on bought wheels. In these cases the density and wear is greatly in favor of thick tire."

Mr. Wilson kindly sent us some records of tire wear, but, like all the others received, there was little uniformity of results.

Mr. J. S. Patterson, Cincinnati, Indianapolis, St. Louis & Chicago, finds that 3½-inch tires give as much mileage per $\frac{1}{16}$ inch wear as 2½-inch tires, and he thinks the thick section most economical. He, however, realizes that the different conditions to which locomotives are subjected in service makes it extremely difficult to judge fairly about wear of tires.

Mr. G. W. Tilton, Chicago & Northwestern, writes:

"I have seen no appreciable difference in the wearing qualities of locomotive tires as between tire made 4 inches thick or those 3 inches. I do not understand how any more compression of the metal can obtain in rolling a tire 3 inches thick than in one 4 inches. The size of the ingot to be used is governed by the size and thickness of the tire required and both subjected to the same treatment, and I do not as yet understand that the metal is made any more dense or subjected to any greater compression in making a tire 3 inches thick or less than in making one 3½ or 4 inches. If there is a difference it certainly will be of value to ascertain just where the line is to be drawn to obtain the best results I have the opinions of some of the tire makers and they claim there is no difference in the metal as between a 3 or 4-inch tire."

Mr. Matt Ellis, Chicago, St. Paul, Minneapolis & Omaha says:

"You will appreciate the fact that this question is one which it is quite difficult to answer definitely or to prepare statistics which will be satisfactory. So many factors are involved in the comparative wear of tires that it is almost impossible to find a considerable number of cases where the circumstances are exactly similar, except the thickness of the tires when originally put into service. The make of the tires, the service of the engine, weight on drivers, size of cylinders, ratio of the weight to cylinder power and even the care and judgment of the engineer are circumstances which would probably affect the wear of the tires much more than any difference produced by the thicker rolling of the metal.

"I have given the subject considerable attention since I received your letter and fail to find any facts to lead me to think that there is any considerable difference between the quality of the thick and thin tires. I enclose a statement showing the wear of tires on 28 locomotives having tires originally 3 inches thick and the same number 4 inches thick. The comparison in no case shows any marked contrast, and is slightly in favor of the 4-inch tires; in one case where these tires were on 18-inch by 24-inch cylinder engines and the 3-inch tires on 17-inch by 24-inch cylinder engines, notwithstanding the fact that the ratio of cylinder power to adhesion was greater on the 18-inch than on the 17-inch engines."

Mr. W. H. Thomas, East Tennessee, Virginia & Georgia, writes:

"We have 3-inch, 3½-inch and 4-inch tires in all kinds of service on this system, and so far have found no difference in the wear. The wear of tires depends greatly upon the engineer in charge of the engine. We have one lot of consolidation engines equipped with standard and another with Midvale tires. The tires on one of these engines were turned several months ago, showing 17,136 miles to $\frac{1}{16}$-inch wear. Other tires of some make on same class of engine and same kind of service, but handled by a different engineer, did not make as good a record. Some men slip their engines and some use more sand than others, so that a set of 4-inch tires under an engine handled by a careful man might show much better mileage than a careless man could get out of a set of 3-inch tires. I am inclined to think that tires of 4-inch and 5-inch thickness can be rolled, and as good results secured as with tires 3 inches thick, everything being equal. I understand a certain firm is now rolling tires by a somewhat different method than has been the custom heretofore. The tire is rolled much larger than required, and is then reduced in diameter to proper size by rerolling, thus securing same density throughout."

Brake Beams.

In the majority of the rules and instructions for the care and use of the air brakes, issued by the various railroad companies for the guidance of their employés, particular care is enjoined not to allow the slack to become so great that the piston will travel over 8 or 9 in. On heavy passenger cars this has to be carefully watched and the slack frequently taken up by dead levers or the under connection of the trucks. That this is not always attended to as promptly as might be desired, especially if it necessitates taking up the lower connection, is apparent to all who have paid any attention to the subject. To determine how much of the piston travel is caused entirely by the springing or deflection of the brake beams in the center when the air pressure is applied, and how much more efficient the brake arrangement can be mad by the use of stiffer brake beams than those in ordinary use, were the objects of the investigations, the results of which are shown in the appended table.

A passenger car weighing 50,000 lbs. would require at 80 per cent. of total weight a braking force of 40,000 lbs. Each of its 4 brake beams would have to withstand a pull of 10,000 lbs. in its center. Or if a car weighing 40,000 lbs. requires a braking force of 32,000 lbs., each brake beam would have to withstand a pull of 8,000 lbs. It has been found by a series of careful experiments, that with new white oak brake beams 3½ × 5½ in., supports 5 ft. apart trussed with two ⅝ in. rods, and loaded in the center under as near as possible the same conditions as in actual use on a car, the deflection was with 8,000 lbs. loads, $\frac{5}{16}$ of an in., and with 10,000 lbs. nearly $\frac{13}{32}$ of an inch. The former represents a piston travel of 2½ in. and the latter 4 in. due to the spring of the beam alone.

Even brake beams 3½ in. × 7½ in. trussed with ¾ in. rods, which would be considered much larger than the average in ordinary use, deflected under 10,000 lbs. load over ¼ in., representing 2½ in. movement of piston in one case and 2 in. in the other. How much more these beams will spring after being in service for a few months and withstanding the pull of the levers several thousand times, when the truss rods have become loosened and the timber shrunk, we will not attempt to state.

A certain amount of lost motion in the pin connections, etc., is unavoidable, and as usually put up with key bolts amounts to rarely ever less than $\frac{1}{16}$ in. in each hole and often ⅛ of an inch.

It will be readily seen that by adding the amount of motion necessary to take up the slack to the amount caused by the spring of the beams, quite a considerable portion of the 12 in maximum travel of the air cylinder piston is consumed in ineffectual work. Add to this the clearance of the shoe from the wheel, say ¼ of an inch, which is a small allowance, representing 2½ in. piston travel with 40,000 pounds braking power, and the great necessity of continually adjusting the connections and taking up the slack is in a measure explained.

From the foregoing statement it will be readily seen that much of this could be avoided by the use of stiffer beams. What would seem most desirable would be a beam combining great stiffness with say a deflection of less than ⅛ of an inch under 10,000 lbs. load, without any loose parts, such as truss rods, etc., to jar and work loose and impair the safety and strength of the beam, without being too heavy or clumsy, and on which the brake head and levers could be readily applied. Several different kinds of wrought-iron and steel beams, or combination beams of wood, plated on both sides with iron and riveted or bolted through and through, are now being made and used to a limited extent. Some of these possess considerable merit, and although when first introduced were not always entirely satisfactory in every particular, yet the defects are gradually being eliminated, and are already much improvement over the old wooden beams.—*Railroad Gazette.*

Wear of Car Axle Journals.

The carriage superintendent of an English railway wrote to us some time ago asking if we could furnish him with data regarding the wear of journals under railroad cars. We applied to the heads of the mechanical department of our leading railroads for the information, and we have been surprised to find that so little is known about the wear of journals. Most of the answers received were to the effect that no statistics had been collected respecting the wear of journals. As journal wear has a direct influence on train resistance, we think it would be wise for our railroad men to ascertain with exactness how much journals are worn under different kinds of bearings and how the bearings influence resistance. Among the answers we received worthy of notice are the following:

Mr. William Garstang, superintendent motive power Chesapeake & Ohio, writes: Our records here show an average mileage of 72,892 miles to the 1-32 surface wear on 58 steel axles in passenger service; 55,371 miles to the 1-32 surface wear on 6 iron axles in passenger service; 37,497 to the 1-32 surface wear on 12 iron axles under 25-ton cars in freight service.

Mr. J. B. Henney, superintendent motive power New York & New England, supplies information showing that the journals under a passenger coach weighing 58,280 pounds was 1-64 inch in 21,580 miles, and the wear of the journals of a freight car weighing 25,510 pounds was 1-32 inch in 28,641 miles.

Mr. J. D. Adams, general master car-builder Boston & Albany, had not collected exact data, but from careful watching of the mileage made by passenger car axles, he believed the wear of journals averaged ⅛ inch for about 100,000 miles run. With a tight axle-box that will exclude grit and dirt the mileage will be considerably greater. He had found that the kind of bearing used materially influenced the wear of journals.

Mr. John Kirby, general master car-builder Lake Shore & Michigan Southern, writes: I cannot give you the data asked for as we have never kept it, and only know from observation of the journals of axles removed from passenger train cars that the wear of journals is largely in proportion to the diameter of wheels. As a general thing, the journals of axles removed, which have 42 inch wheels, will show a reduction of from 3⅝ to 3⅝, making 250,000 miles. Then, when you come to journals in wheels which were 33 inches diameter, but have been turned down to about 31 inches and less, I have seen journals removed, after running from sixty to seventy thousand miles, that have been reduced to 3⅝ inches. Our practice is to use new axles in 33-inch wheels for passenger train cars and use them in one pair only; then turn them over to freight service, after said wheels are worn out. For 42 and 36-inch wheels we do not use the same axle after wheels require second turning. In this way we keep new or nearly new under the passenger train cars.

Mr. J. N. Barr, superintendent motive power, Chicago, Milwaukee & St. Paul, says:

We have no record of the average decrease in diameter of journals per thousand miles run. We have, however, obtained a little information on this point in testing different bearing metals with the following results:

Metals.	Loss in ounces per one thousand miles run.	Loss in diameter of journal per one thousand miles run.	Average mileage.
No. 1	0.762	.0029	26,552
No. 2	1.140	.0014	23,756
No. 3	1.170	.0015	22,018
No. 4	0.810	.0032	26,668

Metal No. 1 is lead lined. Nos. 2, 3 and 4 are bearings of different hardness, 2 being the hardest and 4 the softest. There seems to be, judging from these tests, the following relation: The softer the bearing metal, the less the bearing looses in weight, and the greater the decrease in journal diameter. You will see from these figures that there is about twice as much decrease in journal diameter for the soft metals as there is for the hard metals, and on the other hand about 75 per cent. increase in the amount of metal worn off from the hard brasses as compared with the soft brasses.

Mr. Samuel Irvin, general master car-builder Missouri Pacific, writes: "Relative to the journal wear of axles under American railway rolling stock, would say that a journal of wrought-iron 3¾ by 7, with a filled bearing upon same, filling made of first quality Babbitt metal, costing 23c per lb., wears a journal $\frac{1}{32}$ of an inch less in diameter in 31,000 miles. Of a filled brass, made of poorer grade of material, costing 5c. per lb., the wear is nearly $\frac{1}{16}$ less in 31,000 miles.

Mr. W. F. Turreff, general master mechanic Cleveland, Columbus, Cincinnati & Indianapolis, writes: "Owing to extra work caused by the yearly reports I find it will be impossible to complete an axle record for the year ending Dec. 31, 1888, and have thought best to send you a copy of the proceedings of one of our quarterly meetings held over a year ago, which will show you our instructions regarding the wear of steel axles, which at that time we were using exclusively under our passenger cars and passenger locomotives, also under the new freight engines then built by us, and of what few iron axles we used we had no statistics.

During the last year we have discontinued the use of steel axles and use iron axles exclusively and hope to keep up our axle wear from this on and when completed for the year 1889 will give some valuable information. The figures shown on copy inclosed were made up from actual tests, and what was a source of great surprise to us was that axles running with 42 inch wheels made considerable less average mileage than those fitted with 33-inch wheels.

1. Until a more consistent comparison can be made the following table will govern the limit of service for steel axles under locomotive and car equipment, viz.:

Service.	Class of axle.	Standard size. Diameter. Journal.	Standard size. Diameter. Wheel fit.	Limit size. Diameter. Journal.	Limit size. Diameter. Wheel fit.	Mileage limit.
Passenger.	Driver.	Various	Various	Wear.	Wear.	300,000
	Engine truck.	4¾ in.	4⅝ in.	4½ in.	4⅝ in.	200,000
	Tender truck.	3¾ in.	4⅞ in.	3 7-16 in.	4¾ in.	300,000
	Passenger car.	3¾ in.	4⅞ in.	3 7-16 in.	4¾ in.	300,000
	Mogul.					
Freight.	Driver.	7	7	6⅝	7	350,000
	Engine truck.	5	5	4⅝	4⅞	250,000
	Tender truck.	3¾	4⅞	3 7-16	4 11-16	375,000
	8-wheel.			Wear.	Wear.	
	Driver.	Various	Various	⅜ in.	⅜ in.	350,000
	Engine truck.	5 in. and 4¾ in.	5 in. and 4¾ in.	4¼ in.	4 11-16	300,000
	Tender truck.	3¾ in.	4⅞ in.	3¼ in.	4 11-16	400,000
	Switching.					
	Driver.	6½	6½	6⅜	6½	400,000
	Tender truck.	3½	4½	3	4⅜	375,000
	Car.					
	Passenger.	3¾	4⅞	3 5-16	4 11-16	.....
	Freight.	.....	.....	.....	.....	.....

NOTE.—After making their limit, passenger engine truck axles shall be placed under eight-wheel freight engines to complete their service. Passenger tender and passenger car axles to be disposed of in like manner, and after making their limit under freight engines, if still in serviceable condition, they will be placed under freight cars.

Mogul engine truck axles to be placed under eight-wheel freight engines. Where any tender axles without numbers are running under passenger or freight engines they should be removed as rapidly as possible, the passenger to be replaced with steel axles and those under freight engines may be replaced with new iron axles, if there is not sufficient numbered second-hand steel axles to supply them. Iron axles with or without numbers should not be allowed to exceed the limit above named.

Steam Heating in the Northwest.

At the March meeting of the Northwest Railroad Club hearing passenger trains was discussed. President Reed was in the chair.

Mr. W. A. Lewis, Chicago, Burlington & Northern, read a paper on heating cars with steam. The drift of the paper was to the effect that no system of steam heating has yet been properly developed. The cars heated by steam have seldom got the temperature properly regulated, was inclined to believe that under present circumstances the danger of death to the passengers from pneumonia is greater than from burning of cars. He asserted that there is not in existence now one single system of heating by steam from the locomotive that is reliable under all conditions, and yet by an act of the Minnesota Legislature all the Minnesota roads are required to remove the common stoves before Oct. 1, 1889.

Mr. Barber, Northern Pacific, stated that last winter they fitted up three solid trains with steam-heating apparatus, and took special pains with every part of them. But when they were sent out in weather 20 degrees below zero, or thereabouts, it was not considered safe to let the trains go out without extra coal in the coal boxes in the coaches and the baggage cars. On one occasion, having been warned that a heavy snowstorm was coming, a train was sent with the expert of the steam-heating company on board, and special brakemen selected from among the locomotive engineers who were available. The thermometer went down as low as —45.

Out in Dakota between Jamestown and Bismarck the train struck snow and the locomotive engineer said that he had to have all the steam or else lie there. It was decided therefore to abandon the steam heating and start up the stoves, and orders were given to disconnect and bleed the pipes. There were six cars in the train. Three of them were successfully disconnected and the pipes emptied, but the others froze up solid before the pipes could be emptied or stoves started. The expert froze both his ears and two or three fingers in less than 10 minutes, and if the train had not been provided with stoves the passengers would have frozen to death. Naturally in such climate the difficulties are somewhat greater than on the Atlantic coast.

Mr. W. S. Johnson held that the primary condition of successful car heating is that the cars should be well built with a view to their warmth. He said that you could hardly live in a house built in the manner in which cars are constructed. He thinks 200 square feet of heating surface with 5 pounds pressure will heat an ordinary car in ordinary weather. A difficult question, in the opinion of Mr. Johnson, is that of the trap. A coupling that will not leak can be made, but the question of trap is difficult. The trouble with most traps is that they do not open wide enough and begin to freeze before the water can discharge. In his opinion the question of steam heating of trains will be very quickly solved when a proper trap is introduced.

Mr. J. R. Drozeski, of the Erie Car Heating Co., read a paper describing the apparatus of that company. A train of four cars equipped with the Erie heating apparatus has been running on the Fort Wayne Division of the Pennsylvania system since March, 1887, and left entirely in charge of trainmen. It has not failed for a single day to keep the cars warm, and has not cost more than $10 for repairs.

Mr. E. A. Westcott, Chicago, Milwaukee & St. Paul, said for the past two winters they had a steam-heating system running between St. Paul and Chicago. The first season the train pipes ran under the cars. The cars could not be kept warm. This last winter they have been carried through the cars overhead, but the weather has not been such as to give them a thorough test. So far, however, as the system has been severely tried it has been more successful than that used in the former season. The traps, however, are a failure. If the cars when set out do not stand level enough, water of condensation left in the pipes gives trouble from freezing. This is especially true where there are radiators at each end of the car.

President Reed stated that to heat cars satisfactorily in Minnesota with the Baker heater it required not less than from 400 to 500 square feet of pipe. He has cars running with 440 feet of pipe and gets a free circulation. It takes two or three hours to heat up with the Baker heater.

Mr. Barber, in reply to a question as to the efficiency of the Baker heater, said we have from 175 to 180 Baker heaters in use, and so far they have been satisfactory. We have storm sashes and rubber weather strips on the windows and double floors filled in with mineral wool. Until this winter salt water has been used for circulation, but this winter fresh water is used with better results. The circulation is freer. But one Baker heater has been frozen up this winter, and that was through carelessness. He recently ran a train over the road with the thermometer 18 degrees below zero. The car walls were filled with mineral wool, as well as the double floors. This train ran from 9 o'clock in the morning until 11 o'clock at night with no more than half a fire in the Baker heaters all day, and the cars were perfectly comfortable.

Mr. Matt Ellis, Chicago, St. Paul, Minneapolis & Omaha, saw no reason why coaches cannot be heated by steam from the locomotive if the capacity of the boiler is sufficient. The size of the boiler, however, must be increased.

The President stated that there were but very few boilers running in that part of the country that are adequate to furnish steam for heating and to perform the work of hauling a train of nine cars in very cold weather.

Mr. Lewis thinks that there is not a master mechanic in the Northwest who has sufficient confidence in steam heating to start out the transcontinental trains with no reserve heater.

Mr. Barber asked if the ordinary standard engines would furnish steam sufficient to heat a 10-car train with the thermometer 40 below and a little snow to contend with.

Mr. Lewis thought that there was no question about it. The condensation of the steam used for heating is very slight compared with the evaporative power of a locomotive. He is satisfied that it has required no more steam to heat a train of four coaches after the pipes become thoroughly heated than is ordinarily used by a locomotive in keeping the pumps from freezing.

Mr. Johnson: The Milwaukee road runs trains of six coaches and three sleepers heated by steam, with the thermometer 25 below zero, and keeps them all perfectly warm. The trains are also lighted by electricity, by means of a dynamo, using a 15 H. P. These trains get in on time in weather 30 below zero.

Mr. Barber: I was on that train some time ago, and was awakened at 5 o'clock in the morning to see how matters were going on. I found all the stoves in the sleepers going. The conductor said that the heating was all right until they took on the engine then running. She was not steaming very well, and so they had to light the fires in the stoves. This he said was not usually done. It was a very cold morning.

Mr. McIntosh (Div. M. M., C. & N. W.): There is still an element of danger with the Baker heater. When you have to crowd it to its full capacity it is possible to get too much pressure, and it will blow off at the valves and lose water out of the heater. I have known several cases of that kind to occur.

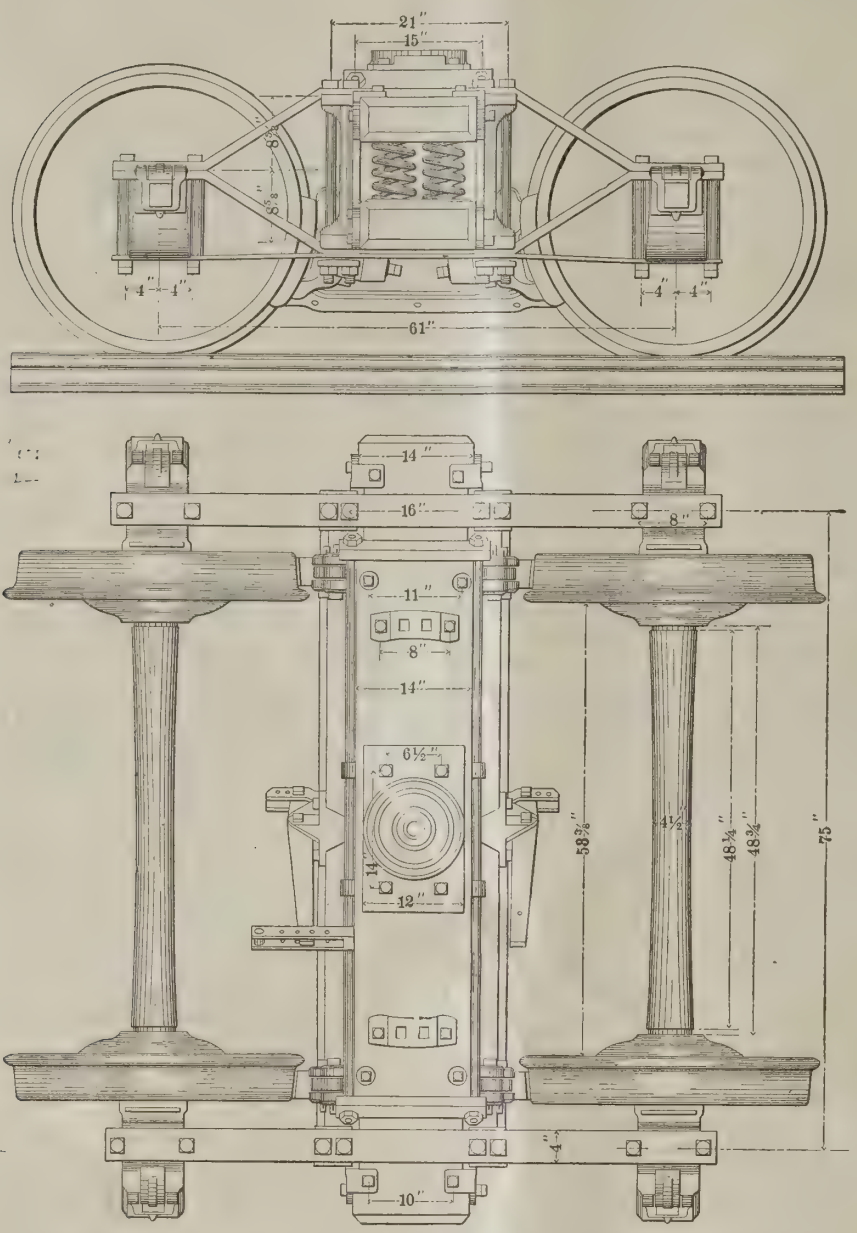
Mr. Westcott suggested that it was negligence that caused the Baker heater to blow off, allowing the water in the pipes to run down and get cold.

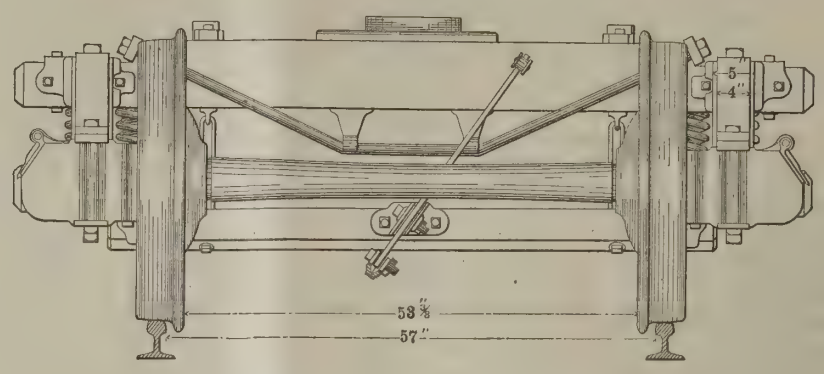
The President said that in a great many cases it was purely negligence. In some cases he had found the fault in the smoke pipe. He had also found that the use of rubber valves is somewhat dangerous, and had known several accidents from them. He had taken off three rubber valves and tested them, and found that they would not blow off at 300 lbs. pressure.

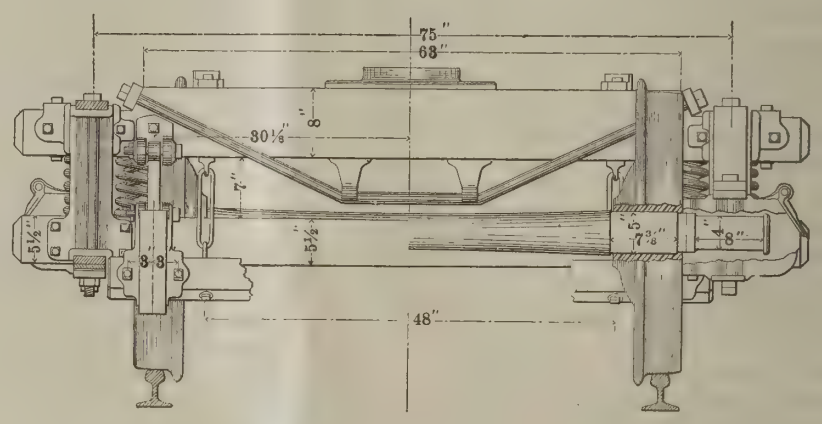
Mr. Barber: We used to have trouble until we changed the valves and put on a safety valve, set at 180 lbs. Then where the pipe comes out, we packed it with mineral wool or asbestos. We require all heaters to be blown off at least once a month and thoroughly cleaned. We fill them once a week. When we find the circulation is bad we usually discover that the trouble is with the water. We fill these heaters from the bottom. In the upright pipe we find a little space which is filled from the top. Out of the 5 heaters that I have had blown off in the extreme cold weather last winter I found the trouble in 4 cars in the cross-over pipe coming down through the floor. The pipe had been covered all except where it passes through the floor, and there it froze for a space of probably 6 or 8 inches long. After protecting this piping there was no more trouble.

Mr. Brunson (Supt. St. P. Union Depot): When we have had steam-heated trains in the depots it has been necessary to have the sectionmen follow them out and flange the track on account of the freezing of the water which had escaped.

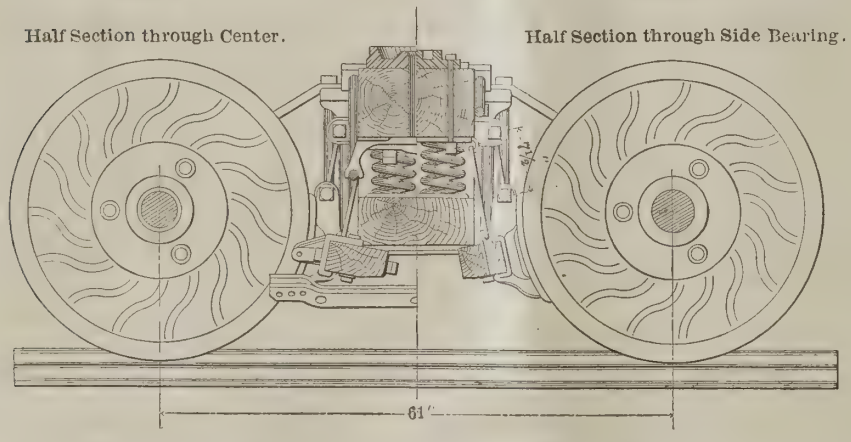
LOUISVILLE & NASHVILLE HEAVY CAR TRUCK.







Half Section through Center. Half Section through Side Bearing.



The annexed cuts represent the "Standard Freight Car Truck" used by the Louisville & Nashville Company for cars of 60,000 pounds capacity. The main features, wherein it is considered superior to the general practice, consist of the equalized double column bolts and the axles.

Large column bolts are conceded to be detrimental on account of removing too great a quantity of the sectional area of metal from the arch bars; smaller bolts are sometimes used in pairs, but the strain invariably acts upon the first, or outside, bolts only.

In this truck the strain is equalized by a double washer, or equalizer, with a slightly convex face bearing on the lower side of arch bars, as shown on side elevation, thus insuring an equal distribution of strains on the two bolts.

The axle has 4″ × 8″ journals, is the same distance (75″) between centers as the Master Car Builders' standard, and is applicable to the Master Car Builders' standard box. The length over all is 84¼″, or 1″ longer than the Master Car Builders' standard.

Notes on Cincinnati, Hamilton & Dayton Matters

We select the following notes from a semi-private letter written to this office by Mr. R. E. State, of the Cincinnati, Hamilton & Dayton Railroad:

We have just taken in engine 133, which has been in service constantly two years and two days, and has made in that time 100,947 miles without being off her wheels, or having her steam-chest covers raised. Of course this is an exceptionally good showing, and we account for the valves and cylinders being in excellent shape by the use of valve oil which costs about 50 cents per gallon. Previous to using this, we used a mixture of black oil and tallow at a cost of 32 cents per gallon, and thought we were doing well when we got 80 miles to the quart for valve oil on passenger engines. We now get with this valve oil anywhere from 160 to 300 miles per quart.

I notice in your last issue a paper by Mr. Hickey, M. M. of the M., L. S. & W., on tender trucks. I heartily concur with him in the design of the tender truck with equalizers, but would hardly put quite as much expense to it as his description would seem to warrant. The truck that he describes as having a monument of bar steel, commonly called springs, I know full well is the case on many roads. They are perfectly rigid, totally devoid of any reasonable chance to curve well, yet they do go round curves, but if they will watch their wheels and find how gloriously they do cut the flanges, and keep an account of the wheels changed for cut flanges that go into the shop, and report wheels removed on account of being mismated, thus cutting the flange, they will soon find it would pay to put in a truck that would have some assurance of curving easily.

The C., H. & D. are having 200 34-feet standard box cars built by the Litchfield Car Company. They are to be equipped with malleable iron draw-bars, also malleable iron "Butler Spring Protector." By the way, have you ever noticed the good points of this protector? We have this Butler spring protector in every car in freight service on this system, some 5,000 cars. While I have no ax to grind on this matter, I do not think it is a device that ought to be better known than what it is.

I note in your last issue the Richmond & Danville people are paying some attention to slid wheels. I know of no one item that will save more dollars and cents to a railroad company than looking closely to the brake leverage and thus protecting the wheels from being slid. For the past two years I have personally watched this matter on this road and have made some experiments to see what is the proper leverage required for a given weight of car. I am aware that Westinghouse recommends brake power about equivalent to the weight carried on the trucks having brakes applied to them. I have been using leverage figured for 60 pounds pressure in the brake cylinder under the car, using 85 per cent. of the weight of the car, and yet I occasionally get a report of wheels damaged by sliding.

Another car that I reduced the leverage to 64 per cent. of the weight of car, and find a report of slid wheels on a wet day. I have about decided the engineer is largely to blame for slid wheels in the manner in which he applies the air. We are applying Westinghouse governors as fast as convenient, but even then we have some trouble but hope to overcome it shortly.

The Pennsylvania Railroad Company about a year ago put down iron ties in a portion of their track on the middle division, but they have not proved a success and will soon be replaced with wooden ties. The principal objection to the iron ties was want of elasticity, but it also appears that they were more expensive than wooden ties even when their longer life was taken into account.

In a lecture delivered by Mr. Andrew Carnegie, in the Franklin Institute, March 18, on Pennsylvania's Industries, he scored the Pennsylvania Railroad Company deeply for the high charges it exacts from patrons. He quoted from the reports of some of the leading railroads to show that the Pennsylvania Railroad charged the largest rate of all upon the transportation of materials. Taking into consideration the service rendered, the Pennsylvania Railroad's rate should be as much less as the reports show them to be greater than those of the other roads. Higher rates are charged by it in Pennsylvania, he said, than it charges in New Jersey.

New England Railroad Club, Annual Social Meeting.

The annual meeting of the New England Club for the election of officers and social intercourse was held in the Revere House, Boston, March 13. Vice-President Richards occupied the chair.

The annual report of Secretary Curtis showed the club to have 196 members and to be flourishing financially.

The officers elected to serve for the ensuing year are President, George Richards; Vice-President, Orlando Stewart; Secretary and Treasurer, Francis M. Curtis; Executive Committee, George Richards, James N. Lauder, J. W. Marden, Osgood Bradley, Robert Johnson, F. D. Adams, Samuel D. Nye, Albert Griggs and F. M. Twombly; Finance Committee, Charles W. Sherburne, James Smith, Carroll J. Post, Joel H. Hills, Daniel S. Page, Isaac N. Keith, Charles Richardson, A. G. Barber and John Kent.

President Richards announced that the subject for discussion at next meeting would be "Compound Engines" to be opened by Mr. Angus Sinclair, New York.

The company then proceeded to the dining hall and engaged in discussing an excellent repast.

Hon. George H. Crocker, railroad commissioner, was the first speaker. He addressed himself to the ladies present and said: When your husbands come home at night and look solemn and wise, it is because they are solemn and wise, and it is because they have had great problems on their minds during the day, the greatest problem being to discover the way in which they can bring the community as near as possible to destruction and still avoid it; and they are solemn when they come home at night because they know that if they spend any time at home and sleep during the night, some other railroad man will get ahead of them.

He then made an earnest plea for the club and others to use their influence for the introduction of automatic couplers, and for the application of power brakes to all freight cars, both improvements being urgently desired to prevent the terrible loss of life from coupling cars and from workmen having to pass over the roofs of cars when trains are in motion.

Mr. Crocker then continued: Now, ladies, I am very glad that you are here to-night, and I hope that once in a while you will ask your husbands, when they come home, what they have done to prevent accidents to brakemen in coupling and uncoupling cars or in setting the brakes thereof, and, if you ask often enough, by the time you come to the next annual dinner of this association there will be a very decided advance in that respect.

I have just one nut to crack with some of the gentlemen here. I have not been long a member of the Board of Railroad Commissioners, but I must confess that during my short experience I have been impressed with the belief that some of the gentlemen here, when they have a visit from a man with an invention, and when they cannot get rid of him in any other way, send him to the Board of Railroad Commissioners. Now, I would like to hear from some of the railroad men a confession of their sins in that respect, and I am prepared to make one myself. I must confess that I have sometimes done the same thing, and sent them back.

Other speakers were ex-Governor Smyth, of New Hampshire; Mr. William Martin, of the Martin Car Heater; Mr. Bolen, of Newark N. J.; Mr. W. C. Tyler, of the *Railway Review*, and Mr. George H. Coney. The latter gentleman spoke a high tribute to the memory of Captain Ericsson and mentioned some of the most important inventions he had given to mankind.

Master Mechanics' Association Circulars.

Secretary Sinclair, of the Railway Master Mechanics' Association, has issued the following circulars of inquiry:

TIRES, ADVANTAGE OR OTHERWISE OF USING THICK TIRES.

1. Please furnish a tabulated statement showing the mileage made during the life-time of a series of heavy and light tires of the same make upon a form similar to the one herewith inclosed.

2. Can you give any figures showing the amount of wear to tires occasioned in handling engines by different engineers?

3. Do not heavy wheel centers with thick tires produce flat spots upon the tread of tires much sooner than light wheel centers with light tires? If so, please send a statement showing this difference.

4. In determining the advantage of a thick over a thin tire, or vice versa, do you take into account the expense of turning tire?

5. To what extent does the condition of tires influence the taking of an engine into shop for general repairs?

6. What is the cost at your shop of disconnecting an engine, taking out wheels, turning tires, and replacing wheels ready for service?

7. In conclusion, state your reason why you think a heavy tire better than a thin one, or vice versa.

NOTE.—The brand of tires will be regarded as strictly confidential by the committee.

HENRY SCHLACKS,
C. E. SMART,
J. W. STOKES,
} Committee.

Replies to be sent to Henry Schlacks, superintendent of machinery, Illinois Central Railroad, Chicago, Ill.

WATER SPACE SURROUNDING FIRE-BOX AND FLUES OF LOCOMOTIVES—IS IT USUALLY LARGE ENOUGH FOR FREE CIRCULATION?

The average amount of steam evaporated from a given amount of coal burned is usually, in the ordinary locomotive boiler, only about one-half of what a perfect utilization of the heating properties of the coal should accomplish. It is believed that much of this waste of heat is due to a restricted circulation of water in the boiler; that is, owing to inadequate passages for the water, the latter is unable under certain conditions to maintain its continuity with the heated sheets.

To the end that this subject be investigated, and that a report be made based on practical results, the undersigned committee ask your kind attention and answers to the following questions: First. Do you think the water space usually allowed between inner and outer sheets of a locomotive fire-box sufficiently large to permit a free circulation of water in contact with the heated sheets under circumstances of a high temperature in fire-box?

2. Have you made any experiments to demonstrate your conclusions? If so please state particulars.

3. Can you suggest a means whereby a better circulation of water in the space surrounding the fire-box would be assured?

4. If you suggest a change in shape of the fire-box sheets to accomplish the purpose, will such change interfere with the space in fire-box allotted for combustion?

5. What width of water space do you suggest as being sufficient between the inner and outer sheets of fire-box? Sides..... Back..... Front.....

6. Do you consider the clearance space usually allowed between the boiler tubes of a locomotive sufficiently large to permit the highest evaporative power at that point under condition of the maximum heat in fire-box?

7. Assuming the boiler tubes to be two inches outside diameter, what clearance space do you allow between them?

8. Do you prefer placing boiler tubes in flue sheets in line vertically or situate them zigzag fashion? Please state your reasons for the preference.

9. Do you favor the use of ordinary crown bars placed in the usual manner for staying the roofsheet of fire-box? If not please state objections.

10. Have you adopted a system of radial stays for crown sheet or any method of staying said sheet differing from the old style crown bar? If so please send the committee sketch showing the manner in which it is done.

11. Do you favor the use of flat or circular crown sheets for locomotive fire-boxes, and which method do you regard the most efficient for transmitting heat?

Please do not confine yourself entirely to the questions asked, but give the committee any information or drawings you may possess tending to improve the evaporative efficiency of locomotive boilers.

Committee, { JOHN HICKEY, J. N. BARR, R. W. BUSHNELL.

Replies to be sent to John Hickey, master mechanic Mil., L. S. & W. Ry., Kaukauna, Wis.

Mr. Charles Blackwell having resigned from the Central Georgia, replies to his circular on "Driver Brakes" should be addressed care of Angus Sinclair, 140 Nassau street, New York.

Master Car Builders' Association Circular.

The following circular has been issued by Secretary Forney of the above association.

ON CAR HEATING.

The Master Car-Builders' Committee appointed to continue their report on the subject of car heating, and in regard to the adoption of a standard coupler, beg to request the following information.

Replies to the questions herewith should be filled in, and this circular returned to F. L. Sheppard, Altoona, Pa., as soon as practicable.

R. D. WADE,
ROBERT MILLER,
F. L. SHEPPARD, *Chairman*,
} Committee.

1. Name of system in use or trial.
2. Number of locomotives equipped.
3. Number of cars equipped.
4. Number of cars in train to which heat can be transmitted.
5. What is the heating medium?
6. What pressure is carried in main pipes?
7. What pressure is carried in heating pipes?
8. How is the temperature regulated, and does it require constant attention?
9. What provision is made for retaining a comfortable temperature when train is not connected to locomotive?
10. If traps are used, what kind and where located?
11. What kind of flexible connection is used between cars?
12. What couplers are used?
13. What have been the general results with couplers and connections?
14. What have been the general results with this system of heating?

(SIGN.).....

.....R. R.

Timlin-Heidinger Car Heater.

Early in the past winter a train of three cars, on the Rome, Watertown & Ogdensburg Railroad, was fitted up with the Timlin-Heidinger system of continuous heating and it is reported to have worked very satisfactorily. This system of car heating uses steam as the medium in ordinary working, and when a car or train is to be left for a time without being attached to a source of steam supply, hot water is used, the supply being stored in a reservoir placed in each car. A Westinghouse air brake coupling is employed and in addition a special composition gasket.

The success of the operation of this system of car heating during two very cold periods, when the thermometer ranged from 15 to 30 degrees below zero at Ogdensburg, was wholly satisfactory. The facts, as reported, are about as follows: No difficulty was experienced with the air brake hose or coupler, and the temperature in the coaches was maintained at 70 degrees with only slight variation, with a pressure on the radiating pipe not exceeding one pound. The pressure on the train pipe averaged about five pounds. No difficulty was experienced by loss of steam power of the locomotive, and the small amount of steam necessary to heat the cars was not perceptible by the engineer. An actual test of the value of a storage tank in maintaining the temperature of a car when detached from the engine was made with the thermometer 10 degrees below zero. The storage tank was filled with water and steam at 20 pounds pressure, and after two hours and 45 minutes the car was at a temperature of 65 degrees. Experiments were made in the presence of the officials of the road at Utica, a few days since, to determine the danger resulting from the escape of steam into a car. In order to prove that dry steam would not burn or scald a person in case of accident, a stop cock in one of the storage chambers was opened after the pressure had been raised to 20 pounds. Those present could place their hands and face in the steam jet without the slightest trace of burning or scalding. This is attributable to the fact that the steam is perfectly dry. It is stated that this system has not frozen up this winter, even when the temperature at Ogdensburg was 39 degrees below zero. The company is devoting its efforts this winter toward the perfection of its devices.

Convention of Railroad Commissioners.

The Inter-state Commerce Commissioners sent out invitations to State railroad commissioners and to representatives of the Association of American Railway Accounting Officers to meet them at Washington to consider business of mutual interest, and a convention formed of representatives from these people met at Washington on March 6. There was a good attendance. It was decided that the conventions should be held annually. The most of the business transacted related to statistical and rate matters, and efforts were made toward a better and more uniform classification of freight. There was comparatively little said about railway machinery, but it is understood that the organization will use its best efforts to promote uniformity in devices used on cars doing inter-state business.

Mr. Rich, of Michigan, brought up the question of interlocking switches and signals at grade crossings. These are in use at about 25 railway grade crossings in that State, and the movement is thought to greatly facilitate the safe running of fast trains.

Mr. Bonham said that in South Carolina the law forbids one railway crossing another at grade. Interlocking switches were not used, as they were too costly.

Mr. Woodruff said the law in Connecticut now required new crossings to be over or under. Stops were required at existing grade crossings of railways except when fitted with interlocking devices.

The following resolutions, offered by Mr. Crocker, were unanimously adopted:

WHEREAS, Thousands of railroad employés every year are killed or injured in coupling or uncoupling freight cars used in inter-state traffic, and in handling the brakes of such cars, and most of these accidents can be avoided by the use of uniform automatic couplers and train brakes; and

Whereas, The success and growth of the system of heating cars by steam from the locomotive or other single source, largely depends on the adoption in inter-state traffic of a uniform steam coupler; and

Whereas, These subjects are believed to be of pressing importance, and within the proper scope of the powers of the Congress of the United States, while attempts on the part of the individual States to deal with them have resulted, and must continue to result, in conflicting regulations;

Resolved, That we do respectfully and earnestly urge the Inter-state Commerce Commission to consider what can be done to prevent the loss of life and limb in coupling and uncoupling freight cars used in inter-state commerce, and in handling the brakes of such cars, and in what way the growth of the system of heating passenger cars from the locomotive or other single source can be promoted, to the end that said Commission may make recommendations in the premises to the various railroads within its jurisdiction, and make such suggestions as to legislation on said subjects as may seem to it necessary or expedient.

Brake Gear.

"The Master Car-Builders' Committee on Standard Brake Gear for Air Brake Cars and Brake Shoe for Iron Beam" proposes to make tests of the different forms of iron beams on the market.

Manufacturers of beams have been requested to forward beams for test, but the committee understands that there is much private investigation under way, into the subject of iron beams, by various railway companies and individuals connected with railway companies.

The committee is anxious to make its report to the Association as complete as possible and would be glad to communicate with any person having beams which they would like to submit for examination and report to the Association.

The committee has stipulated to the advertised manufacturers that the beams sent for test shall not show a deflection of more than $\frac{1}{16}$ inch under a load of 15,000 pounds.

All parties desiring to communicate with the committee on the subject of brake beams will please address their communications to Edward B. Wall, superintendent motive power, Pennsylvania lines west of Pittsburgh, Southwest System, Columbus, O.

(Signed) EDWARD B. WALL, Chairman.
G. W. RHODES, Supt. M. P., C., B. & Q.
GEO. HACKNEY, Supt. M. P., A. T. & S. F.

Car Heating on the Fall Brook Road.

Mr. W. A. Foster, superintendent motive power of the Fall Brook Coal Company, writes us:

Perhaps you would be interested in our experience in heating passenger trains with steam from the locomotive.

The Martin system is used, and has proved entirely successful, but in the last cars fitted with it the system of pipes inside of the car has been simplified.

As first put in, there was a 2-inch pipe running lengthwise of the car on each side, with stub pipes projecting under each seat.

In the last cars 2½-inch pipe was used in place of the 2-inch and the stubs were left off. A car was first tried with 3-inch pipe, but this was found to have too much surface radiation.

The 2½-inch pipe without stubs heats the car as well as the 2-inch with stubs. It is simpler, cheaper, and, in case of a collision, less liable to be damaged.

The pipes are all boxed in, which is a protection to the clothing of passengers and makes the car cleaner and neater.

We consider it a great improvement in every respect.

Railway Car Construction.

BY WILLIAM VOSS.

Seventh Paper.

PLATFORM OR FLAT CARS.

Of all the different classes of cars required for the proper and economical operating of a railroad, the platform car is the simplest and cheapest to construct, but its life is also the shortest. It is less able than other kinds to resist the shocks a car is subjected to in ordinary train service, and is often broken in two or down at the ends when other cars are not in the least injured, and in a collision or other accident it is usually the first to succumb. It may be fortunate enough to escape these as long as it is new and fresh, but a comparatively few number of years at best will terminate its existence, the exposed condition of its frame inviting premature decay, the bane of all wooden cars.

This state of affairs can be remedied only by substituting for this perishable material some other that is not affected by age, or at least in an imperceptible degree only. Iron and steel are the available materials for this purpose, and it is perhaps safe to predict that they will in the near future be very extensively used for the principal members of the frame, if not for the entire car. The somewhat higher first cost and the want of an altogether satisfactory design, are at present the obstacles in the way of their more general adoption. The difficulties of constructing being the least, and the ravages of time telling the most on flat, gondola, and all open cars, are the reasons why the manufacturers of iron cars have devoted their attention principally to these, expecting, by means of these to them favorable conditions, to more than balance the additional first cost by the increase in the life of the cars.

The wooden flat-car body consists of a trussed framework covered with a plank floor; the frame differs from that of other cars only in that the side and end sills are made heavier for the purpose of stiffening the frame. The change in framing necessitated by this has been fully described in a former paper, and need not be repeated here. The only other feature of these cars is the stake-pockets, with which it is customary to supply them. These are made of cast-iron in an unlimited variety of sizes and patterns, a few of which are shown in the accompanying cuts. Their weight is about 10 pounds, and to reduce this, if not the cost, they are sometimes made of malleable iron or pressed steel, but at present not to a very great extent. The opening allowed for the stake in these pockets is about 3½ by 4 inches at the top and a trifle less at the bottom, the wedging form securing a firmer and closer fitting stake. The pockets are distributed along the side of the car at intervals of from 4 to 5 feet, the usual number for a 33 or 34 feet car being seven; two are attached at each end, at one end to the inside face of the end sill, and at the other to the side of the intermediate sills at a distance of about 18 inches from the edge of the floor, this extra space being necessary for the working of the brake when the car is loaded. A ⅝-inch U bolt or staple surrounding the pocket is used for attaching them in their respective places, with the nuts and moderate sized washers on the reverse side of the timber.

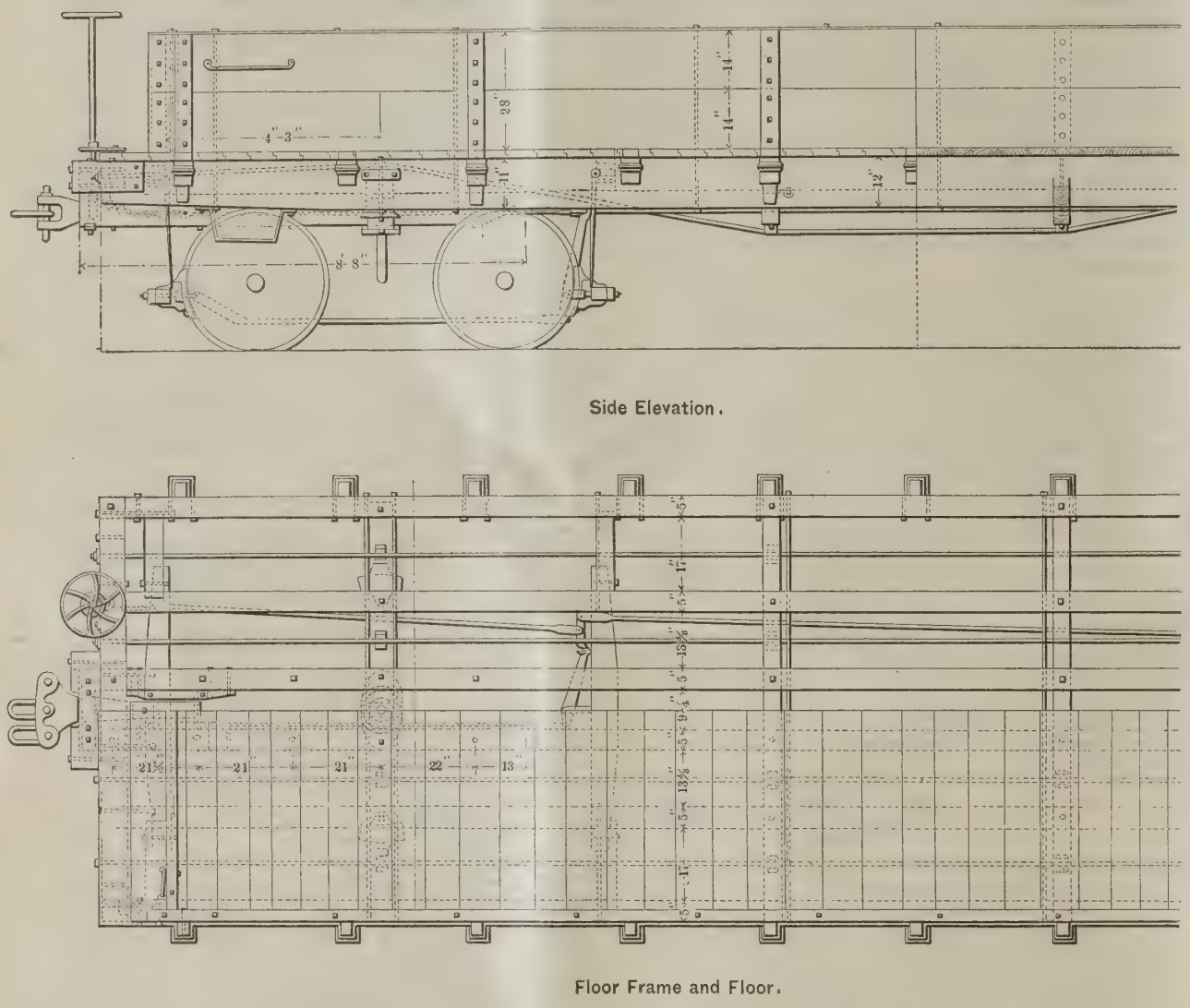


Fig. 64

Another, if not so convenient an arrangement for all purposes, consists of a series of permanent stakes pivoted to the side sills by a single bolt. The upright position of the stake is maintained by a suitable hook and staple, and when not in use it is folded back on the side of the sill, where it is supported by a stop or bracket.

GONDOLA CARS.

A gondola car is a flat car to which has been added an open box constructed with planks and stakes in a substantial and permanent manner. It is principally used for hauling coal, but differs from coal cars proper, whether four or eight wheeled, mainly in the arrangement of the floor or bottom of the box, which is built level, although a pair of drop-doors or even a small hopper may be applied in the center between the cross-tie timbers, while the floor of a coal car is laid on an incline, the whole bottom forming a hopper, the intention being to empty the car of its contents without labor. This and other conditions make it a car to be used for coal exclusively, while the gondola car can be utilized to transport a number of other articles, chief among which are rails and lumber.

Fig. 64, one of the many types, will answer as a sample for the purpose of description. This car is fitted with eleven pockets on each side; six of these are used for the stakes supporting the box, and the remaining five for the application of temporary stakes when the car is used for lumber or other comparatively light freight. The side of the box is formed with two 2¼ by 14-inch pine planks, extending in one piece from one end of the box to the other; they are fastened to oak stakes with ½-inch bolts. Short planks secured with nails were formerly used, but, proving very troublesome to maintain, are at present found on temporary racks only. The top edge of the plank is faced with a ¼ by 2½-inch strap of iron, intended to protect it, but may, perhaps, better be dispensed with, as the wear on

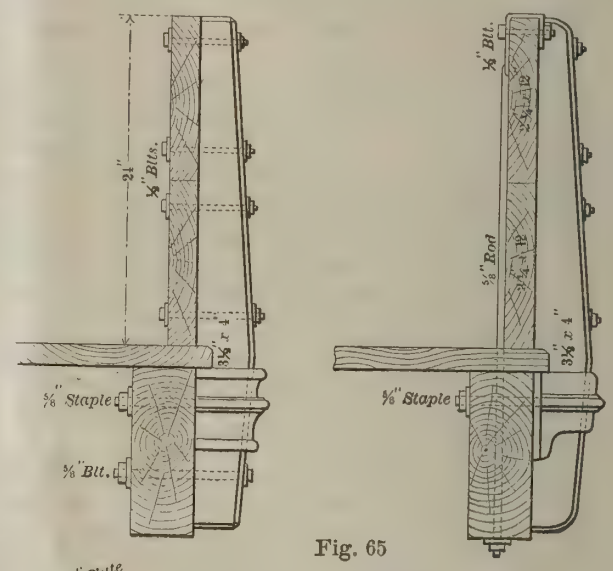


Fig. 65

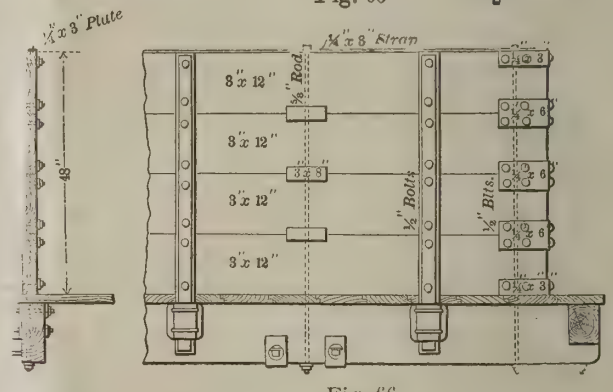


Fig. 66

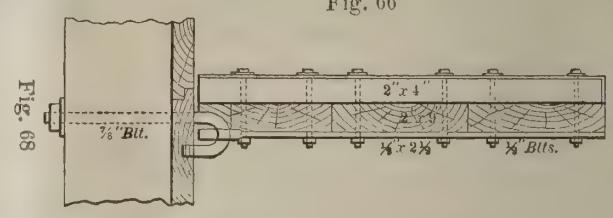


Fig. 68

these parts is but slight, and anything that unnecessarily increases the cost and dead weight of a car should be avoided.

The side of the box is by the addition of a few bolts or rods made more substantial, and the carrying capacity of the planks thereby added to that of the frame. A very reliable and economical method to make the side and sill practically one is shown in Fig. 65. The stake is simply attached to the sill immediately below the pocket by a close-fitting ⅝-inch bolt. The same, and perhaps a somewhat better, result is accomplished by a series of hook-rods applied as in the second cut of the same figure. The upper end or hook is of flat iron and is kept in position by a ½-inch bolt; the lower end passes through the sill with a nut and washer on the under side of this. The planks in Fig. 64, our sample car, are secured in a similar manner, but instead of the rod being placed to one side of the planks, it is passed through these, thereby dispensing with the hook and the bolt securing it. This plan is also adopted when the side is framed with key-blocks, the rod being used to hold these in place.

Key-blocks are, when properly fitted, and the side is of sufficient thickness to prevent flexure, a desirable and an inexpensive means to strengthen the car vertically, especially when the planks used are so narrow as to barely support their own weight without bending. The strength of a plank, other conditions being equal, is increased in proportion to the square of its vertical thickness. When but 6 inches deep it is in strength to the one 12 inches deep as 36 is to 144. This would make a side 3 feet high, and consisting of three 12-inch planks twice as strong as one of the same height composed of six 6-inch planks. The latter when framed with a sufficient number of key-blocks would in *theory* be thereby made six times stronger, or be three times the strength of the one constructed with 12-inch planks.

The ends of the box or rack are closed with either stationary or hinged gates, the former making a much cheaper and stronger box, and should always be employed when it is possible to do so, but owing to the fact that it is incon venient for loading and unloading some kinds of freigh-

especially long lumber and rails, and that it is impossible to carry the latter when the box is not long enough to receive them but the car is, it is frequently the case to find drop-gates on the longer cars and nearly always on the short ones, providing the total length of the car over the end sills is not less than 30 feet, which is the length of a rail.

The two forms of stationary gates in use are shown in Figs. 66 and 67. The stakes for the support of the planks constituting it are in both cases like those used on the sides, have the planks fastened to them in the same manner and are located as described on the platform or flat cars. The difference between the two figures consists in the manner of securing the corner. In Fig. 66 this is done by a series of wrought-iron corner-plates placed on the exterior and covering the joints of the planks, and frequently, in addition to this, by a like number of similar plates on the inside of the corner. These plates are ¼ inch thick and 6 inches wide, excepting those placed near the lower and upper corners, which are 3 inches wide. All extend 10 inches each way from the corner and receive eight and four, respectively, ½-inch carriage or square headed bolts.

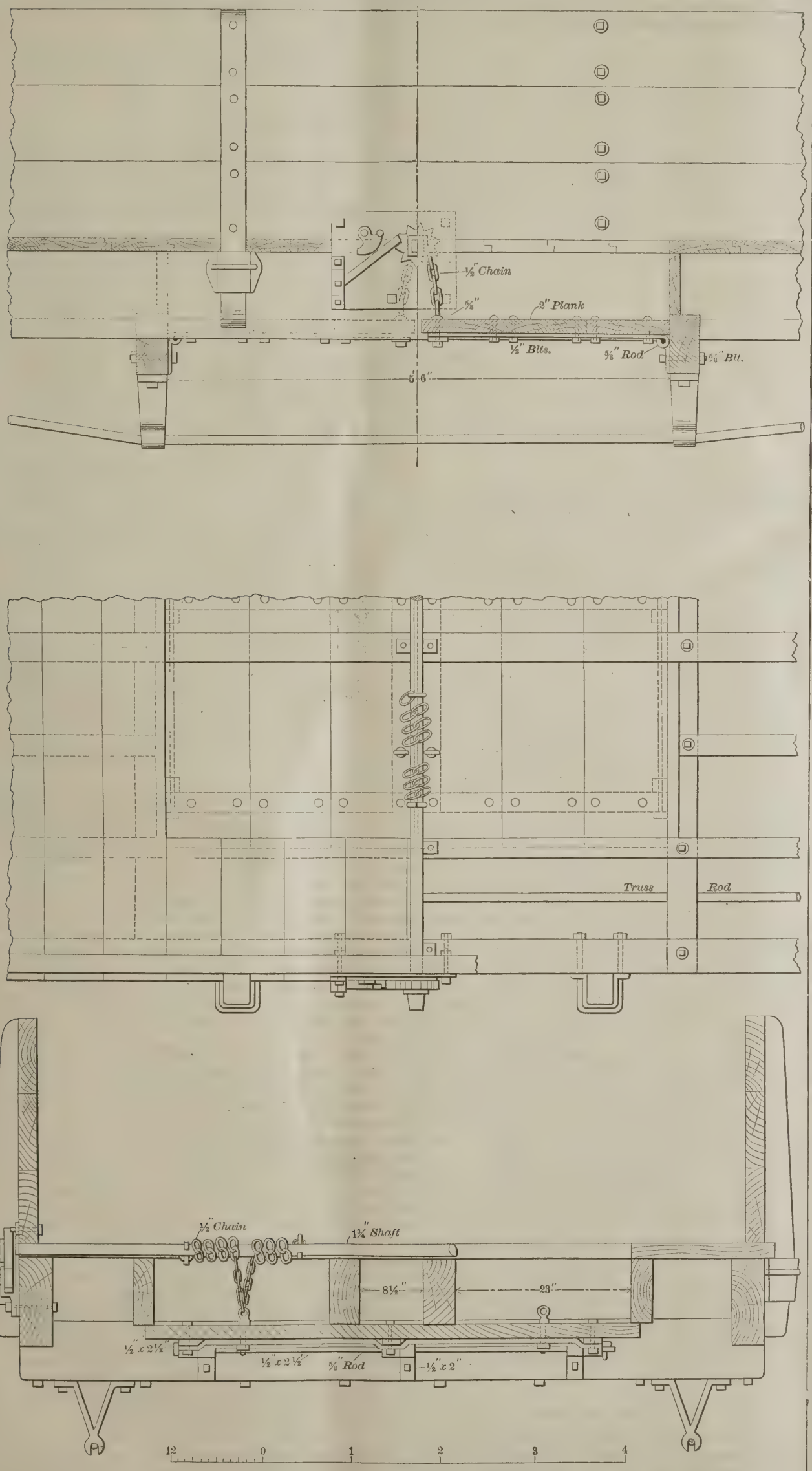


Fig. 69

Fig. 67 is a cheaper, but, perhaps, as substantial a way to accomplish the same result. The side planks extend beyond those at the ends a distance of about 4 inches for the purpose of attaching cleats. These cleats are of hard wood, 2¼ × 4 inches in size, secured with two ½-inch bolts to each plank, the same as the stakes, and serve to keep the end planks in place. One or more ⅝-inch rods extend through the side-planks, cleats and end stakes to prevent the spreading of the sides. To prevent the end gates from rising it is only necessary to bolt the stakes to their supports or use separate rods, as already described.

The same end framing without any alterations is often used when cars are fitted with drop-gates, but ordinarily the stakes and tie-rods are omitted, the latter being supplemented, as in Fig. 64, by hooks and staples, one in each upper corner, which, in addition to the duty required of them to prevent spreading of the sides, also serve to maintain the upright position of the gate. The hooks should be substantially made of ⅝-inch round iron, and eye-bolts made of the same size iron be used in place of ordinary staples. The gate in Fig. 64, consisting of two planks of the same thickness and width as those used on the sides, are joined by four rods, the intermediate rods terminating at their lower extremity with an eye which engages with a ⅞ or 1-inch hook or eye-bolt extending through the floor and intermediate sill, the whole forming a hinge on which the door operates. The opening in both eyes and hooks must be sufficiently large to avoid injury to the parts when the door is lowered and the floor space under it had not previously been cleared of all foreign matter, such as small pieces of coal or stone.

A somewhat stronger drop gate, and one that is less liable to get out of order, is shown in Fig. 68. A strap of ½ by 2 or 2½-inch iron terminating with an eye like the rod described is placed on the inside face of the planks, while a hard-wood cleat 2 × 4 inches, is immediately opposite, both being secured by the same bolts. The hook bolts in the floor, and the cleats and hooks attached to the sideboards, are the same as those used in the preceding cut.

To facilitate the unloading of coal from gondola cars, these are frequently fitted with drop-doors, which are constructed and operated similar to those on coal cars proper. Their application without the hopper is inexpensive, and requires but few, and those not very material, changes in the frame of the car. The two long-body truss rods in the center are omitted to make room for the doors and the intermediate sills, or two of these only when four are used, terminate at the cross-ties. Fig. 69 shows the doors in elevation plan and sections. The distance between the cross-ties is governed by the width of the doors, and this again by the height of the car above the rail. The latter being 36 inches from the bottom edge of the middle sills, as established by the M. C. B. Association, and after deducting 3 inches for the clearance of the hinges, etc., admits of a 33-inch door, or 5 feet 6 inches between the tie-timbers. The space between these and the floor and between the sills is stopped with suitable pieces of planks or boards; the center of the draw-sills, remaining undisturbed and extending across the opening, may be covered with short pieces of flooring or be left exposed, as the door extends across the opening between them. The doors are composed of 2-inch oak plank, substantially combined by three long hinges forged from ½ or ⅝ by 2½-inch bar iron, secured with ½-inch bolts. The counterparts of these hinges, made of somewhat lighter iron, are attached to the sides of the cross-ties with bolts or lag-screws, one ⅝-inch rod serving as a pin for all three. The lower side of the door near its front edge is further protected by a strap of the same size iron, shaped as shown, and through which pass the eye-bolts provided at the end of the chains. A winding shaft, 1½ or 1¼ inches in diameter, extends across the frame of the car and rests directly on the sills, the floor at the side of the opening being cut away to make room for it; thin pieces of iron are, however, introduced between the shaft and the sills to avoid excessive friction. One end of the shaft is forged square and with a collar in the center of the square part; the portion outside of the collar is for the application of a winch, and that on the inside to prevent the ratchet-wheel from turning on the shaft. The other end of the shaft, on the opposite side of the car, is provided with a key and washer. The winding shaft-plate, carrying the pawl or dog, is securely fastened with a bolt in each corner, two of which pass through the side-sill. Each door is connected with the shaft by two ½-inch chains, attached to the door with a ⅝-inch eye-bolt as mentioned, and to the shaft with a ½-inch eye-bolt or a substantial split-key of ½-inch half-round iron, care being taken in spacing the holes in the shaft for these to secure a uniform winding of the chains.

To avoid a complicated system of brake-connections when brakes are applied to both trucks, and particularly when these are operated by air pressure or some other continuous system, a slight alteration is made in the above-described arrangement. The doors may be hung as above, but must then be made in sections so as to leave the space below the center sills clear for the introduction of rods and pipes; but as this doubles the number of the doors and increases the number of other parts, they are more frequently applied in the opposite direction, the hinges being attached to the intermediate sills, or if these are cut away to the drop-door side timbers in this case provided.

The brake-shaft on flat and gondola cars is located in the same relative position as on house cars, and extends above the floor for a distance of from 33 to 48 inches, the height on gondola cars being governed by the height of the box, as the hand wheel must be some inches above this. The usual variety of brake-shaft steps and upper bearings

carrying the pawl is found on these cars, but commonly the latter is a simple piece of flat wrought iron let in flush with the floor of the car, and like the pawl, fastened with lag screws, the projecting part having a perforation through which the shaft is inserted.

The exposed location of the shaft rendering it liable to injury and distortion from a shifting load, having in some instances to be entirely removed to make room for this, calls for an improved construction which will allow the shaft to be quickly detached in all such cases. A very simple, and the only practical manner in which this can be done is shown in Fig. 64. The ratchet-wheel and that portion of the shaft on which the brake-chain winds are of one piece of cast-iron, with a square opening through its center, to which the shaft proper is forged to fit. When not in use, the shaft is carried in suitable hooks or brackets on the side of the car.

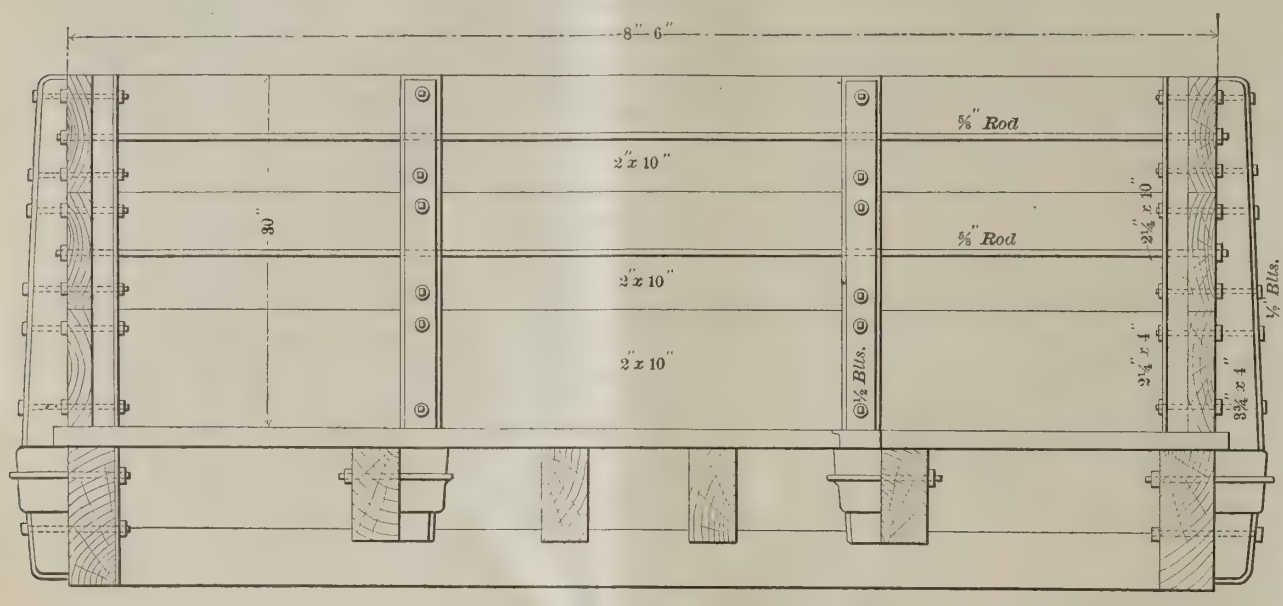


Fig. 67

The usual difficulty experienced to keep anything not bolted fast with the car presents itself here, and to overcome this a very ably designed contrivance has been invented. The shaft is fitted to a square socket as above, but cannot be altogether withdrawn from it, and when raised a certain distance exposes a hinge which allows the shaft to assume a horizontal position. The fact, however, that it is difficult and dangerous to work between the cars when it is in this position is quite an objection.

Gondola cars are almost always, but flat cars only rarely, provided with the means to assist trainmen in mounting. A step of the usual size and pattern is attached in the usual place, and immediately above this a handle to the ide of the box, but this on the brake end of the car only, as there is usually no room for a person at the other end.

Axle for 60,000 Pound Cars.

At the March meeting of the Western Railway Club this subject was again discussed.

Mr. John Hickey, Milwaukee, Lake Shore & Western, spoke of the stress laid on retaining the M. C. B. distance between center of bearings, and questioned the propriety of sacrificing other details of a good design in order to retain this one. Held that the size of the journal is the fundamental part of the axle, and that the other parts should be proportioned to suit. Thought it would be well to retain the M. C. B. distance between centers if it could be done without impairing the proportion of others, but did not see that it could be done. Could see some drawbacks to retaining the old distance between centers in a new axle, for it was likely to lead to confusion among car repairers and inspectors, and might interfere in the interchange of cars. Was against making the dust guard space less than 2½ inches long, because the dust guard should be thick and its retaining walls sufficiently strong to resist the end thrusts.

It is claimed that when an axle has rendered safe service in cars of high capacity, it can be transferred to cars of medium and light capacity, until it is entirely worn out. If cars of less capacity than 40,000 pounds were to be continued in service, which is doubtful, the construction and situation of arch bars will not in many cases permit the introduction of the large axle, and if they were so fitted as to receive it, it is questionable if the complications incident to a change of axles and brasses would not be more expensive than retaining separate axles for the different classes of cars. While a certain amount of duty in ordinary service will not affect the strength of an axle, yet it is certain that a large number of revolutions, in connection with the shocks. and strains and changes of temperature of a car axle, is followed by a reduction in strength; and in handing it down from one class of cars to another, we may be asking from it too many revolutions for safety. The greatest pressure brought to bear on railroad companies at this period of railroad work is in the direction of getting freight cars of higher capacity. The old cars, or cars having a less capacity than 40,000 pounds, are rapidly enlarging the scrap pile. There are several good reasons for this. Railroad companies can haul freight at less cost per ton a mile, in cars of high capacity; cars of low capacity are usually of frail construction, and when placed in trains in connection with heavy and high capacity cars, they are unable to withstand the shocks of their overgrown neighbors, and the result will be a total wiping out of the light weight cars. So we need not worry about axles for lighter cars than 40,000 pounds capacity. This will practically leave the field in possession of two classes of cars, namely, those having a maximum capacity of 45,000 and 65,000 pounds respectively. The body framing the draw gear, the body and truck bolster, the arch bars of truck, the springs—in fact almost all parts of the car must, of necessity, be different, caused by the great difference in loads. If all these things must be of different design, where is the great harm in having a differently designed axle? To say that a six-wheel truck would be the right thing for heavy cars is not meeting the question of a suitable axle for a four-wheel truck, and the country would be flooded with all styles of axles for heavy cars before we could convince people that such a move would be the most economical. From a conservative standpoint it plainly appears that cars of 60,000 pounds capacity require axles and wheels and oil boxes of special design, and after a due amount of service, if it is desired to change it to cars of lighter capacity, let it be so designed that by cutting off the outer collar and replacing it with a new one at a distance from the inside collar, suitable to the truck in which it was intended for use. Submitted a sketch showing the dimensions of axle and oil-box for 60,000 and 65,000 pound cars, the inside collar of journal being the same distance apart as the M. C. B.; and if it is desired to change it to the latter, simply removing the end collars and welding others in their places, at a point that wil give a bearing of seven inches from inside shoulder of bearing. In doing this you can also discover any existing defects. This shows the axle, as in use on some cars, on the M., L. S. & W. for the last fifteen months; also the axle in the Master Car Builders' box and the box got up for the 60,000 pound car. From my experience in this business, and in running cars of high capacity for the last twelve or fifteen months, I should say that an axle with a bearing less than 4¼ inches in diameter and 8 inches long would be too small. The dust guard bearing should not be less than 5 inches diameter and 2½ inches long, and the wheel fit should not be less than 5¼ inches by 7½, and the axle at the center should not be less than 4⅝.

A long discussion ensued, but nothing was brought out different from the expressions previously made on the axle question before the same club. The drift of opinion was in favor of an axle 6 feet 3 inches between centers, claims were advanced for the favorable consideration of a collarless journal, and a motion was made asking the club to indorse a journal $4\frac{1}{4} \times 8$ as the proper size for adoption. The principal speakers were Messrs. Rhodes, Hickey, Schroyer, John Mackenzie, Forsyth, Gibbs and Crosman. An effort was made to commit the club to recommending full dimensions of an axle; but after these points had been taken up the discussion came to a premature end by a motion to table the subject.

Notes of the Soo Shops.

T. A. Fraser, Gen. M. M. of the Minneapolis, St. Paul & Sault Ste. Marie R. R., in designing the shops of this company, located at Minneapolis, Minn, spent several weeks in traveling among the largest and most modern shops in this country, with the natural result of obtaining all that was new, with the addition of several original ideas of Mr. Fraser's.

Owing to the splendid condition of the equipment, it is only necessary to operate the shops five days each week In the car shops, a new idea in snow-plows, or excavators, rather, is being put into shape, the design being that of a resident of Minneapolis, but not an official of this company's. The plan is simply a flat inclined plane, with sides extending in front of a flat car. On the top side of this plane or trough, and running from bottom to top, is an endless belt, fitted with cross strips, similar to a grain conveyor. This device carries the snow up to the top of the trough, where it is delivered to a fan, the province of which is to throw the snow to one side. It certainly promises good results.

A very fine car, similar externally to a baggage car, for the purpose of shipping trotting horses, and lately the property of Commodore Kittson, is also in the car shop for repainting.

The car shop stands opposite to the machine shop, with a transfer table common to both between them.

The machine shop is modernly arranged, and has a splendid outfit of modern tools. Mr. Fraser has fitted the entire machine shop and round house with hydraulic lifts, the water pressure being supplied by two sets of pumps, pumping constantly and automatically against a fixed load, thus preserving at all times a fixed pressure of 80 pounds. This allows of complete protection against fire, as this water pressure is carried over the entire plant. It is used for washing out engines, lifting work into and out of the tools, handling stacks, cabs, etc., on to and off the engine, and at a great saving will handle drop tables.

To take wheels from under an engine three systems are in use: First, to jack the engine up; second, by means of overhead traveling cranes to lift the engine. On a wealthy road the latter plan may be preferable, but as the strain of lifting comes entirely on the walls or their equivalent, the latter must be specially built at an increased expense for this purpose; and, third, by means of drop tables. The latter was Mr. Fraser's preference.

These tables located on convenient pits are certainly cheap and simple, and are controlled by a single lever, admitting or discharging water under pressure, to or from under the lifting rams.

In the round-house three pits are fitted with these drop tables. One is calculated to merely drop the drivers to repair or replace a broken driving-box, etc., or to do any of the necessary work known as running repairs incident to a removal of the driving-wheels. As an instance, over this pit at the time was an engine which had broken an eccentric rod and left just enough of the rod attached to the strap to form an effective punch, as was shown by a long slit in the front water leg of the fire-box. Ordinarily this engine would either have to go into the *shop* proper, to the device for removing drivers, or be jacked up in the round-house. With Mr. Fraser's idea, the engine had her front wheels only lowered out of the way in three minutes after the disconnection, thus allowing the boiler makers to at once get to work to patch the leg. This round-house drop table is in two sections, so that either the front or back wheels may be lowered, or two pair of a Mogul or ten-wheel engine at a time. Another pit is fitted with a drop table for the truck, which may be lowered on to a trolley, pushed to one side and raised between the pits for repairs. A specially well-designed device was the cinder pit. This was a track, one rail supported on columns four and one-half feet high. On the same side and on the lowered track a train of flat cars stood, The cinders and ashes, being cleaned from the engine, were at once cooled by water from convenient hose. The cinders and ashes were then on a level, or nearly so, with the top of the flat cars, on to which they were loaded with no necessity for lifting them. The deep cinder pit gives ease of access to the ash-pan, etc.

The oil and waste-house is built at a distance from all other buildings, and is specially fire proof. The oil is held in large cylindrical tanks, which are enclosed on the first floor, and well ventilated. At the office end of the building large water gauge fixtures attached to each tank extend into the office. These gauges are 1¼ inches in diameter by four feet in height. Thus each gauge shows not only the *kind* of oil, the height in the tank, but in addition by a scale back of each glass, the actual quantity in gallons in each tank, thus exhibiting a constant inventory of oil on hand. A raised track allows of oil being run from tank and directly into the oil-house tanks, also of rolling oil in barrels *horizontally* to a floor over the oil-house tanks, from cars to be emptied into the tanks. In another room, on the office floor, is located an iron waste safe, divided into three compartments for different grades. This safe is supplied, as are the oil tanks, from the floor above through man-holes. Excessive care has been taken to ventilate every part of this building—even the waste safe and the oil glass gauges have separate ventilation, insuring the escape of all inflammable gases, etc. The piece-work system is to be introduced.

The Cincinnati, New Orleans & Texas Pacific awarded a contract last month to the Schenectady Locomotive Works for the building of eight new engines. Three of them are ten-wheel passenger engines and two are Moguls, both classes having cylinders 19 by 24 inches. There are three switches with cylinders 18 by 24. All the engines will have Boies wheels, boilers of Shoenberger steel, Eames driver brakes and all modern improvements.

Communications.

Inconveniences of the Metric System.

Editor National Car and Locomotive Builder:

Having read with interest your editorial on the subject of the Metric System in the Shops of the Master Car Builders, as proposed by the Boston Club, and also the interesting and instructive paper on the same subject by Mr. Geo. M. Bond in your March issue, I think it will be well for me to say a few words in explanation of such references as have been made to me, which references may not be fully understood. Those who appreciate the faults of the metric system (as those do who have practiced it for many years) must thank you both for the position you have taken.

Mr. Bond says he has it from me that the French do not use decimals in any way in making change. Before writing the article Mr. Bond paid a visit to Philadelphia and spent some time in discussing the subject with me. I told him that the use of a decimal system of metrology or a decimal currency did not in all cases teach people the theory of decimal arithmetic.

There are many governments issuing money, in which the unit, as the dollar of America and the franc of France, is divided into one hundred lesser coins for the purpose of convenience in change. Forty or fifty years ago we issued a coin called the half cent, but as it was found to be of little use, it was abandoned, so that now the half of a yard of cloth worth 75 cents per yard costs us 38 cents. Not being able to divide a cent the seller claims the half cent above the real half of the price of one yard.

While in England I questioned the shopkeepers about their idea of our currency, and they in almost every instance said they could not understand it as they knew nothing of decimals.

It is surprising to note with what rapidity an English salesman will compute change or value or any matter connected with their, what seems to us, complicated system of pounds, shillings, pence and farthings. I am inclined to think that they have kept in use the rules of what was called practice in the old way of teaching arithmetic. When in France, Germany and in Sweden and Norway, I paid great attention to the methods in vogue with the people as relates to their currency, which is decimal, and I came to the conclusion that the use of a decimal currency did not necessitate a theoretical knowledge of decimals. I have many times in computing cost of purchases added the third decimal to denote the fraction of their smallest coin, and in no instance among the common people did I find that they understood what I meant. To them the half of 75 is 38, in the case of the 75 being of their smallest coins, but in the case of 75 francs or 75 marks, then the half is 37.50, meaning 37 of one coin and 50 of the other.

I also told Mr. Bond that when the kilo was found to be too big for the use in small trade they legalized the half kilo, and it is in the minds of the people as the unit, in buying butter, sugar and the like. Sugar they can buy by the gramme, as they have no other weight comparable with our ounce; but in such matters as butter, the pound prints can be most readily cut into halves and into quarters. We cannot fight against nature for the sake of scientific accuracy.

When the metrical system was introduced into Germany the story is told of a person wanting to buy a *pound* of butter; the dealer corrected the term by saying, "You must call them *kilos* now;" to which the would-be purchaser replied "Well, it's all the same; give me a pound of kilos, I don't care what you call it."

Yesterday, asking a druggist how the metric system got on in his place, he replied, "O! I have one customer who sends in prescriptions worded in grammes," and he handed a sample prescription to me. This called for, of the drug .50, in water .100. The druggist had delivered 50 grammes in 100 milliliters of water. The writer of the prescription was a horse doctor, who used the German names for the drugs, with French weights and measures, and the directions in Latin. In this one drug store, they had but this one metric customer, and they secured him after he had failed to get some other druggist to understand what he wanted.

Mr. Bond has mentioned the trouble involved in the change of system. The house of William Sellers & Co. in Philadelphia, after having introduced the metric system into their brass department and used it for nearly forty years, while condemning it, yet continue its use because it has become fixed by reason of the sizes adopted as standards, and to change would involve needless trouble, besides leading to error.

Let me call attention to what may not be known by all in reference to the size of plots of ground. A lot 24 feet front in one part of the city of Philadelphia is not so wide as a lot 24 feet wide in another part of the city, the difference being, perhaps, one-quarter of a foot, or three inches. This comes from the fact that in former times before the act of consolidation the many smaller towns, now united and called Philadelphia, had each its system of surveying and its standard tape line. It is well-known in the Department of Surveys that the tape lines used were not alike, differing by as much as one-eighth of an inch to the foot. And I know of a case in which the old line in a large city was ¼ inch too long to the foot. To make the record agree with the ground as originally laid out, the defective lines are still used, each being confined to its own proper district. From this, perhaps, comes the caution in most deeds when the feet and inches are given, to add the terms "more or less." It is very much easier and more satisfactory to continue the use of the defective scales used to measure the land in the first place than to try to readjust all to a standard that may or may not be accurate.

In regard to the custom of the French in using the old foot and inch to designate the height of man, in common talk, this is not confined to the novelist; it is common with people in every-day life, as the stone is the weight used by Englishmen in giving their weight. In regard to its use in literature, I read in a French novel published in 1885 that a man is "haut tout au plus de quatre pieds neuf pouces." This 4-foot 9-inch man is not our 4 feet 9 inches high, nor is he 1,450 millimeters, for the old French foot, or the "Pied du Roi," was 12.79 of our inches, and so the 4-foot 9-inch man is about 5 feet high. M. Alphonse Daudet, in his last book, "L'Imortel," translated by Remington Bramwell as "One of the 'Forty,'" uses the foot, not the meter, and the "lieu" in place of the kilometer. Where he speaks of a six-mile dusty ride, in the translation, we read "six lieux" in the French text, the license of the writer.

A learned writer discussing this matter of the customs of writers, says, in a recent letter to me, "It is a simple question of taste, and no writers are so minutely particular as to style as the French. The old system of weights and measures has become thoroughly rooted in literature, and the introduction of the metrical standard would strike the critic as a solecism—an affectation of scientific accuracy totally out of place in a work of elegant literature. * * * * All languages have their duplicate vocables in which old-fashioned words and ideas survive in pure literature long after they have been banished from everyday writing and conversation."

The late Hon. Charles Sumner was an earnest advocate of the metric system. He was for compelling the people to adopt the system at some fixed time. He said: "Let us have no more of this want of system when we have a scientific and perfect system already in use by many nations, ready prepared for us." As a step in this direction a postmaster general, struck with the simplicity of the French system, ordered a postal scale graduated to the French system, in place of the ounce and half ounce. It so happened that the graduations were rather close, and the figures beginning with 15 grammes for the half ounce. Then 30 grammes for the one ounce, and so on, required that they should be placed in two lines, one over the other, in alternation. He was astonished at the complication, as compared to the simple scale of ! 1 ! 2 ! 3 ! 4 ! 5 !, with the half mark between each.

$$\text{Compare}: \begin{cases} 30 & 60 & 90 & 120 & 150 & 180 & 210 \\ 15 & 45 & 75 & 105 & 135 & 165 & 195 \end{cases}$$

The Hon. Charles Sumner was one of those who legalized the 15 grammes as equal to our half ounce. The postal laws of this country call for the use of the ounce avoirdupois of 437½ grains troy. The half ounce is 218 75 grains troy, while inasmuch as one gramme is 15.43315 grains troy; 15 grammes is 231.497225, say 12 grains more than the half ounce of the postal scales. The learned lawmakers in Washington said you may call 15 grammes one half ounce, but it must weigh no more than the half ounce in common use. The United States half gramme is not as heavy as the half gramme of France by 12 grains.

It is an historical fact that the Hon. Charles Sumner, when he came to realize that every scale beam in the United States must be thrown away or regraduated, and all the weights in use by the poor dealers in groceries and the like must be replaced by new weights not understood, and when it was shown to him the many millions of dollars this one change in weight alone would cost the people, that he then dropped the matter as impracticable.

At the present time with both systems legalized, and some few doctors writing their prescriptions in the metric manner, yet not one druggist out of one hundred is fitted with the gramme weights, most of them preferring roughly to translate the French weights into the ones in common use. It is presumable that some do this correctly while the chance of error is very great. Having made it a matter of study to note the tendency towards the adoption of the metric system, I have been in the habit of asking druggists as to the progress of the change, and I am certain that the system is now less frequently used than it was ten years ago.

Inasmuch as one grain is equal to 0.06480 gramme, then in the case of such drugs as strychnia given in pills of one-sixteenth of a grain, such doses expressed in the metrical system will read 0.00108 of a gramme, which is meaningless as compared to $\frac{1}{16}$ grain, even to those familiar with the system.

What is the meaning of all this outcry for the enforced adoption of a foreign metrology? It is that there may be uniformity in the science of the world. There are many nations speaking many languages and each content with his own. These many nations use the weights and measures given to them by their law makers. They become accustomed to them and like them better than ones with which they are not familiar. So far as their wants are concerned what they use is satisfactory. When they come to deal with other people, they soon learn the value of the new weights and measures that are brought to their notice. This is well known by those who have traveled in other lands, as they, when in each country, adapt themselves to the customs in regard to money and what can be bought for money with surprising ease. It is the readers of books who feel the need of a common metrology to save themselves no little trouble. The want of one common language is as needful as the want of a common metrology.

The countries that now have adopted the meter, and the system based on the meter, can make a great advance on the commensurate metrology by making their meter a very little longer than it now is. By making it 40 inches long in place of 29.37043, that is .62957 of an inch, or say $\frac{5}{8}$ of an inch longer, the centimeter would be $\frac{4}{10}$ of an inch and 25 millimeters be in truth 1 inch, the size they make the 25 millimeters when it is in the form of one of Whitworth's inch taps.

It was Sir Joseph Whitworth himself who proposed this, and he told me when I saw him, not long before he died, that he hoped I would do my best to bring about this change.

I have already shown in former papers on this subject that we would be no better in regard to our calculations by the use of the metrical system. It does not save figures, nor does it simplify calculations in many instances. The fact that a cubic meter of distilled water weighs one tonneau, or ton, of water, is no great matter, for the weight of a cubic meter of any other substance must be calculated by the table of specific gravities, as we now refer to tables for the weight of a cubic inch or a cubic foot.

I would urge those who are ready to take up the metrical system to begin at home. When a pane of glass is broken in their house, they can, if so inclined, tell the glazier to bring a light 228 by 253 millimeters to replace it rather than the well-known 8-by-10 glass that has been fractured. Their wives, proud of a ten-pound infant, must be told that it weighs 4½ kilos, which will not sound as impressive as the good old ten pounds. If the good man of the house himself measures five feet ten and one-quarter inches in height, he must learn to give his height as one meter 78 centimeters and three millimeters, or more concisely in millimeters as 1,783 millimeters. The one who happens to be 1,776 millimeters high, or a little slack of five feet ten inches, can remember it by connecting this with the Declaration of Independence.

In my lectures on engineering practice, I have laid great stress on systems of shop sizes, showing that the greatest economy comes from the adoption of a series of sizes that will be sufficient to meet all cases, and be readily memorized. The inch taken as the unit lends itself admirably to such a system, as has been shown by me in former papers on this subject, and by Mr. Bond in his recent letter to this journal. Inasmuch as the Whitworth and the other series of screw threads, as well as the merchantable sizes of bars of iron, have fixed the English and American series of shop sizes, the one adopted in metric countries are as near to these sizes as their metrology without fractions of the millimeter will permit.

Gearing is constructed on two systems in this country, one the even division of the circumference into pitches that are expressed by the distance of one tooth from the other measured on the pitch or engaging line. Thus we have ¼-inch pitch, ⅓-inch pitch and so on up to as large a tooth as the strength of the wheel calls for. Wheels so constructed have their diameters, not in even inches but in inches and fractions of inches not easily expressed without the use of decimals. To bring the distances between the shafts into even inches and fractions of an inch, the per inch system was adopted applicable to all cases save the rack and pinion. On this system the pitch is expressed by the number of teeth to the inch of diameter. Thus a wheel of one per inch has one tooth to each inch of its diameter, the distance between its teeth on the pitch line will be $1 \times 3.1416 = 3.1416$. A wheel of 12 teeth one per inch will be 12 inches in diameter. A wheel of two per inch will be six inches diameter for 12 teeth, and the pitch will be 1.5708, or the half of 3.1416. The series in common use is 14 per inch, the finest in shop use, up to one per inch, three per inch being very nearly the same as one inch pitch, that is 1.0472 inch. The advantage of this system is the capability of combining with the same distance between shafts two or more pitches according to the strength required. This is very useful in the back gears of lathes and in cotton and woolen machinery.

The French, to meet this, proposed a very good substitute that answers the purpose well. They give rise to a series expressed by the millimeter to the diameter, say from 1 millimeter measured on the diameter to as many millimeters as may be required. Suppose they want a wheel about equal to a wheel of 1-inch pitch they would choose 8 millimeters on the diameter; $8 \times 3.1416 = 25.1328$, which is very close to 1 inch pitch. When this system was proposed, it was deemed very much better than our per inch system, inasmuch as the name of the diametrical pitch multiplied by the number of the teeth gives the diameter and the name multiplied by 3.1416 gives the true pitch. Here again, granting the utmost to

the system, we have the alternate of the same with the inch unit. We can take for gearing a unit of one-sixteenth of an inch and treat it as they treat their millimeter and we have the counterpart of their system. We are used to the sixteenth unit in machine screws and a tap 4×16 is a tap ¼-inch diameter 16 threads to the inch. We are fixed in our gearing by reason of the great number of costly patterns that fill the lofts of the machine shops, and the costly but economical series of cutters made on the inch unit by the leading houses.

Machine shops used to working in both systems, while they prefer that in use here, feel no special annoyance in getting an order for machinery to the metric sizes. The Baldwin Locomotive Works have built many locomotives for countries using the metric system. It is very easy to reduce the dimensions that must be adhered to into inches and fractions and the work will bear inspection with metrical gauges.

Mr. Bond has shown how the shop sizes in use in metric countries have to be memorized with no regular increment of gradation to aid the memory, while the binary division of a unit permits the selection of a series easily expressed and requiring only the knowledge of the increment of increase to be carried in the mind. This could be done with the metric system by taking the centimeter as the unit and dividing it by continual halving into say eighths. It cannot be done with a decimal division for the reason that too many standards are already fixed as a unit divided naturally. The Savants, who invented the metric system, had nothing to call their attention to the work shop. They took the earth as the foundation of their system and mismeasured it. They would have divided time decimally. On the 5th of October, 1792, the new calendar was established by law. It made 100 seconds in a minute 100 minutes in an hour, 10 hours in a day, 10 days in a week, three weeks in a month and 12 months in the year. Thus 100,000 seconds made a day, 30 days made a month and 360 days a year. The five or six odd days in the natural year having no place were called days without breeches and were to be devoted to games and frolics. The quadrant of the circle was also divided decimally into 10 parts and each of these again into 10. The quadrant of the meridian containing 100 degrees of 100,000 meters each, was to be 10,000,000 meters, and the circumference of the earth to be 40,000,000 meters in length. All this bearing on pure science was finally abandoned because of its inconvenience, and nothing is left of the great system but the part applicable to the yard stick, pound weights and measures of capacity, and these were imposed against great opposition by compulsory laws without regard to their inconvenience.

I cannot do better than repeat what I said as a member of the committee of the Franklin Institute to consider this subject in 1876, that the objections to the universal adoption of the metrical system are overwhelming, where we consider the compulsory means proposed, or the end to be attained.

The first step towards testing the value of a new system of metrology is to become used to it by practice. We meet people every day who are used to the metric system in relation to a limited number of examples requiring expression of weight or dimension. Thus a chemist using the the metric system of weight in his laboratory becomes quickly used to it and likes it. I see no reason why he should not. I would myself doubtless do so had I fitted my laboratory with weights on that system. An assayer in the United States Mint, after having been away from that work for a time, told me he was surprised at the ease with which he forgot the whole system, and how readily he adapted himself to the use of the grain in place of the gramme and its subdivisions when he was at work in a different laboratory.

The act authorizing the use of the metric system of weights and measures reads "That from and after the passage of this act it shall be lawful throughout the United States of America to employ the weights and measures of the metric system, and no contract or dealing, or pleading in any court shall be deemed invalid or liable to objection because the weights or measures expressed or referred to therein are weights or measures of the metric system.' To enable those using the system to comply with the law with some degree of certainty, the Government publishes in connection with the act a set of tables of the equivalents to the metrical system to denominations in use. See "A statement concerning the relation of the lawful standards of measure of the United States to those of Great Britain and France," by J. E. Hilgard, Assistant United States Coast and Geodetic Survey, p. 129, *Journal of the Franklin Institute*, Vol. 79, 1880, being the number for February of that year.

Until quite recently there has been considerable uncertainty in America as to the length of the meter as compared to the yard. There is no difference between the measures and weights of Great Britain and the United States.

You, Mr. Editor, have shown that the master car builders cannot change sizes that have become standard; they can only change the name of these dimensions. Mr. Bond has made this clear in many examples. This being the case, it is in the power of each member of the Master Car Builders' Association, to make these changes in the nominal size and weight of what they have to deal with. He will soon tire of the experiment, and grow better satisfied with the system in use. If he wishes to test the matter in calculations of strength and the like, he will find little at his hand to help him. Few books in English can be found that will enable him to express his equations in metrical terms. If he reads French or German, he can refer to some of the engineers' text books in either of those languages, but he will find himself contending with more figures. This I have proved many times by calculations made by myself, and also by directing my draughtsmen to calculate matters given to them in terms of the metric system, and then noting the length of the calculation and the number of figures involved. The English-speaking writers have given us a wealth of text books that are full of valuable information, and full of labor-saving tables and formulæ. Are we to give these up when nothing is offered in their place? Many years ago I made this assertion, and I was answered that the books will come when they are wanted. They have not come, and hence I infer they are not wanted.

I do not belong to the school of metrology that holds the inch as a God-given unit, a sacred unit. I hold it is a convenient unit and one that lends itself to economical methods in the shop. The inch is valuable in a system when naturally divided by continual halving. This sort of division can be expressed in vulgar fractions or in decimals, just as in our currency we have halves and quarters expressed by .50 or .25.

Mr. George M. Bond, in taking up his pen against the introduction of the metric system into our shops, writes from a full knowledge of the system and its faults. He is attached to a company noted for its exactness of methods and for the wonderful accuracy of the devices for measuring issued by them. They have had great experience in working for governments using the metrical system. When such men speak against a system, they do it, not from any ignorant prejudice, but from a full knowledge of what is best and most economical. No one can accuse such people of being inclined to stand in the way of progress. It is to the Pratt & Whitney Company that we are indebted for a vast amount of active work in the direction of the most advanced scientific accuracy combined with practical utility.

When I began the use of the metric system I was in no way opposed to it; on the contrary, I recognized all that was good in it, and regretted exceedingly the evils that showed themselves after long familiarity with it. Knowing that the Pratt & Whitney Company had filled many orders for foreign governments I naturally asked their opinion on this subject, and finding that they agreed with me, I was not surprised, for I felt sure that any one having their opportunities to judge must come to the same conclusion. It would be vastly to their advantage on the score of profit if the metric system was to be enforced. It would open up to them an enormous amount of work in replacing the gauges in all shops. Their opposition to it, and particularly Mr. Bond's opposition, is to be looked at as what would be expected from men seeking exact truth, regardless of selfish ends. To advocate the metric system is to gain a certain amount of scientific renown. To oppose it is to be considered an old fogy, an ignorant retarder of progress. Mr. Bond, and you, Mr. Editor, as seekers after scientific truth, have the moral courage to take the side that is in opposition to the men who consider themselves an authority in such matters, but who have not had a large experience with both systems, nor have they a full knowledge of what is really needed to still farther perfect what is now placing our mechanical industries in advance of those of all other nations.

Since sending you my commnication on the subject of the metrical system I have received a letter from the Department of Modern Languages of the Stevens Institute of Technology on the subject of the nominal height of people.

Prof. Charles F. Kroeh says, under date March 8: "Like yourself I find that Germans and Frenchmen uniformly state their height in feet and inches. The weight you will frequently hear in pounds, but I think the rising generation will adhere to the kilogramme." This still further confirms what I have stated. It is rather strange that they should give their weight in pounds, for the scales in common use are fitted to give the weight in the new terms of kilogrammes. So far as weight is concerned, it is used mainly in reference to what is not lasting. It makes no matter what they call the unit that governs the amount of extra luggage we carry through the country or the food we buy and consume. It is mainly with dimensions that the car-builder will have to deal. It will be useless for him to adopt a new measuring rule unless it yields him some good in return. This I can assure him it will not do.

Coleman Sellers, E. D.

Favors Throttling Locomotives.

Editor National Car and Locomotive Builder:

I am a reader of your journal as well as of other mechanical papers, and in many articles I see on working a locomotive there are much the same expressions as to the throttling of the steam. As I understand it, it matters not how light the work is to be done. Now here is the point, and permit me to use the often-repeated expression, "what everybody says there must be some little truth in," so I may be permitted to say what most every one does must be near correct. In the February number you write under head of "The Webb Compound Locomotive," "so long as a large proportion of our locomotives lose the direct advantages due to the use of high-pressure steam through the prevailing practice of throttling the steam till 25 per cent. more or less is lost," etc. I have been stumbling around among locomotives in different capacities since 1851, and have run several locomotives several miles with light loads, heavy loads, fast trains and slow trains, and with no trains, and I must say I never yet found any occasion, any condition of circumstances, that reminded me that it was for the best interest for the locomotive, in case of the working of the engine or for economy of water and fuel, to open the throttles to the full extent and do the rest with the lever; and I never rode with an engineer that worked his engine that way. Don't remember of ever hearing it talked of among engineers that so and so worked his engine with a wide-open throttle under all circumstances.

If the wide-open throttle is correct, it does seem strange that no one, as far as I know, has accepted it as the correct method of working a locomotive. Do theory and practice *always* go together slick and smooth, leaving no cracks? Theory is often accepted as sound doctrine, but practice is what does the work, does the business. From my limited knowledge of locomotive engineering, I would give it as my opinion, were I to run a locomotive all day with *wide*-open throttle, that I would have to ask permission to close throttle a little when I wished to change the reverse lever; if not, I would have to ask help of the fireman, as I am of the opinion, it would not reflect much good upon my knowledge of friction, if I attempted to do it alone. If you will admit there is much friction on the valve while working at short point of cut-off under a wide-open throttle, to that extent, that it would not be prudent for one man to attempt to change the reverse lever, you also admit, I think, that there must be some wear and tear to valve motion in all its various parts, and further, an engineer cannot feel contented to ride upon an engine cut off at a point where from her action it would convey the impression she was working against herself. Permit me to ask if you think and are convinced that this wide open throttle is the only true way to work a locomotive? We ought to have an improved throttle, so made, that whenever it was opened, it opened wide. That would control the question and save this 25 per cent. of loss, now going on on our locomotives through the country.

H. Kingsland.

[Some comments on this letter will be found in our editorial columns.]

Why do Some Engines Burn More Coal than Others Doing the Same Work?

Editor National Car and Locomotive Builder:

As so much is being said about combustion in locomotive fire-boxes and means of improving same, with a view to greater economy of fuel, it may be interesting to note how this fuel, the cost of which forms such a large portion of the operating expenses of railways, is handled and used by the men in charge of locomotives. While traveling lately I have been much impressed with the fact that in many cases carelessness in firing and running engines is more responsible for extravagant consumption of fuel than faulty conditions of fire-boxes or draft appliances, and I have no doubt that if some of the intelligence that is now being spent in devising improvements in fire-boxes, stacks and front-ends was directed to impressing upon enginemen the necessity of carefully using fuel and guarding against waste of same, the labor would be more richly rewarded.

On a recent visit to Chicago I received permission to ride upon the engine during the last forty miles of the trip. I carefully noted the way the engineer and fireman performed their work, and the following is a correct account: As engine was starting the train, the fireman put in a fire of five shovelfuls of coal. The engine was working full stroke and quite hard. In consequence of which, and low heat of fire, steam pressure fell from 145 pounds to 120 pounds. Injector was started immediately, and although the fireman worked hard and did not spare the coal, the gauge continued to indicate 120 pounds pressure.

When within about a mile of the next station the injector was shut off, although a heavy fire had just been put in, and there was yet room for a great deal of water in the boiler, as glass was barely more than half full. The consequence was, steam pressure rose to blowing off point almost at once, and steam began to blow off. The fire-door was pulled wide open and left so for over half a mile until steam was shut off for station, when the injector was started, to quiet the noise I suppose, and fireman seized the opportunity to shovel into his already very hot fire *twelve* shovelfuls of coal.

The train was held at this station several minutes, because of a freight train in the way, and the fireman, to improve the time, put in three more shovelfuls of coal; and then within a minute, and without the engine having moved a foot, six more; making twenty-one shovelfuls of coal without engine having used a pound of steam.

When train finally started four more shovelfuls of coal were put in, and during the whole trip the fireman appeared to have but one wish, and that was to get all the coal he could into the fire-box regardless of its needs, or the amount of steam already on hand.

No method or system of running the engine, feeding the boiler or firing was adhered to, everything was done by fits and starts—generally fits.

The reverse lever never got back of the 12 and 10-inch cut-off, and throttle-lever was always pulled out to a sort of butting post the engineer had constructed out of a large one inch iron nut fastened to the throttle slide by the thumb-screw, which allowed about one inch of throttle opening. The injector was worked as fancy prompted, sometimes shut off when steam was shut off approaching stations and left off until stop was made and engine started, then put on again. At other times it was left on while steam was shut off, and while stopping at station, and during the engine's struggle to regain speed after leaving station; and then, after engine was working at shorter cut off, the injector would be shut off from pure necessity, as boiler would be too full of water.

The train was an accommodation, stopping at all stations, and used one hour and 55 minutes in running the forty miles. About two tons of coal were burned.

The engineer said he had run an engine 25 years.

I thought if he had to ever account for all the mischief he was responsible for during those 25 years I pitied him.

Shortly afterwards, in company with the traveling engineer on same road, I rode upon another engine over the same piece of road, but I am happy to relate under different circumstances. This, too, was an accommodation train and stopped at all stations. From the start the engineer and fireman appeared to understand their business.

Just before starting the fireman put in a fire of five shovelfuls of coal, which proved sufficient to keep up steam until after the train was well in motion and reverse lever pulled back to 10-inch cut-off, when another fire was put in and injector started. As speed increased reverse lever was pulled further back to 5-inch cut-off and throttle pulled wide open.

The consequence was lighter exhaust and decreased coal consumption and greater speed; so much so, that before a mile was run the steam had to be throttled to keep down the speed to what was desired, about 30 miles per hour.

While steam was shut off approaching and stopping at stations, the injector was kept working, and blower slightly on to prevent smoke or changing temperature of boiler. Just before starting the fireman would always put in a fire of from three to six shovelfuls of coal, as circumstances and his judgment suggested. As the engine started the injector was always shut off, and was left off until engine had reached high speed, and was working with short cut-off.

This method of running engine, feeding boiler and firing was kept up regularly during the trip. Scarcely a ton of coal was used in running the forty miles. The time used was one hour and twenty-five minutes, thirty minutes less than was used in running same distance and making same stops on previous occasion. One more car was pulled, and fully one ton of coal less was burned.

There was no noticeable difference in size, equipment or condition of either engine, but there *was* a difference in the crews, and in the manner they performed their work, and I thought I had found a little light on a question I had often thought of—why do some engines burn more coal than others in doing the same work?

Observer.

Oil Box Covers.

Editor National Car and Locomotive Builder:

"Axle Box Covers" being one of the subjects before the M. C. B. Association at the next meeting, and one of some importance, a few thoughts thereon may not be out of place.

There are quite a number of forms in use. The three principal ones are the "Hewitt, Fletcher and Wells;' others are minor in use and importance.

The writer has had an equal experience on all the above, therefore can speak from an unprejudiced standpoint.

Before discussing their relative merit a little reminiscence may be of interest. Some thirty years ago, more or less, a plate cover was used, fastened to the box with bolts or set screws, it being necessary to use a monkey wrench to open the box for examination or oiling by withdrawing one bolt and slacking the other. Then it took as long to open one oil box as it does a dozen now with the improved covers, and often the hammer was used. And what a percentage of cars were running without any covers!

Do you know, Mr. Editor, that there are some cars and engine tenders in the country yet with these covers on with the addition of a ¼-inch hole drilled in the front for oiling. An improvement was found necessary, and a spring hinge cover was devised which could be bolted on to the boxes that had been using the plate covers. This was considered just the thing, that all our troubles were over, but one winter dispelled that idea, as the hard pounding soon sent the improvised covers into the ditch, there were more hot boxes in those days than now, and the temper in the spring was soon no good, then the rattling commenced, which soon sent the cover to dust.

When the Master Car Builders' axle was adopted in 1873, a new axle box was necessary. The one designed had a spring-hinged cover, too well known to necessitate description, its weak point soon appeared in the many loose covers and others entirely gone caused by loss of temper in the spring, and too much wear on the hinge bolt, yet there are a few roads that attempt to maintain this rather expensive cover.

In 1885, Mr. R. Wells, then master mechanic of the Jeffersonville, Madison & Indianapolis, devised a cover that came nearer being the ideal box cover than anything in use at that time. It is now in use on many of the Southern roads, and not a few north of the Ohio River. Its strength was in the spring pressure being under the hinge bolt, thereby holding the cover tight to face of the box; the spring being about 3 inches wide, had good wearing surface, thus increasing the life of the cover, over any spring hinge cover before or since. Its weak point was the liability of spring to lose its temper in case of hot box, which at once made it a rattle-box and its life would then be short.

Later on the Fletcher cover was brought out; it proved superior to any of the previous ones. It is too well-known to require any description here, only to comment on its weak points. This cover is held to its position by a bolt at one end, a spiral spring being placed between the head of bolt and face of cover, to press the cover tight to face of box. The same objections that have not been remedied, were found with this principle, as all the previous ones, *i. e.*, when the box got hot the spring lost its temper, resulting in the cover becoming so loose that, although closed as soon as the car moved, it would drop open; also if the cover had been by carelessness or by oversight left open, it would not close itself by motion of car or gravity. There are two serious objections to this principle, which have made it quite evident that no cover with spring attachment will answer the purpose. What is required for a successful cover is one that will close itself if left open, that can be opened without use of bolts or keys, that has no spring attachment, and will not pound itself to pieces over rough track.

This brings us to the last principle of oil-box cover I propose to discuss, and that is the Hewitt cover. This cover is used in more cars than any other, if not all other covers; doubtless the issue will be between this cover and the Fletcher, when brought before the M. C. B. Association, although a majority, if not all the committee, are Fletcher men. The Hewitt cover is the simplest of any in use now, having no springs, no hinges, no bolts. It works by gravity, and if left open will close itself as soon as car moves. It is kept in its place by ears or guides on each side of box opening, will not loose off except it is broken viciously. The Hewitt principle has been tampered with by some self-styled improver and spoiled. One important road, not a great distance from New York, thought to improve it by putting a shoulder across the back of the cover near the top, so that when the cover was closed it rested on the top of box instead of between the guides. The natural result was that the cover was loose and soon pounded itself to pieces by breaking off one or both of the guides. It's an open secret, Mr. Editor, this same great road condemned the Hewitt cover and are using another pattern. The first of which they used was put on wrong-end-to, or left handed. I presume you will condemn me for telling tales out of school, but it's no less a fact. It is also true that there are car builders when they do get a good thing don't use it properly from pure ignorance, then condemn the principle and throw it out.

There is one correct way to use the Hewitt principle of box cover that makes it the most successful cover now in use, and if this was adhered to there could and would be no exceptions found with it. First the cover should be ⅛ inch narrower at the bottom than the top, the guides set to the same angle, when new, the cover should close the opening and fit tight in the guides at the same time, the top end projecting not more than 1½ inches above top of opening. The opening in front of box should be 5½ inches wide by 4½ long, the cover should be 6 inches long, or high, the lugs on side of cover to hold it in the guides should be near the center, and when the cover is closed, when new, the lugs should be at least 1½ inches above bottom of guides. This will prevent the cover resting on the lugs at any time, which is too often the case with Hewitt covers not properly constructed, for as soon as the cover wears down to the lugs, resting on the bottom of the guides, the life of the cover is short because it soon pounds itself to death by breaking the top end of guides out and then the cover is lost. This is the principal error made in the construction of this cover, and, because of this, the Hewitt principle is condemned by those that run into this error. A close observer will soon notice the weakness in the Hewitt principle, but too few will apply the remedy. Although there are many that favor the Fletcher cover that have never used the Hewitt, there are some that have used the Hewitt and changed to the Fletcher, principally because of the defects mentioned. The writer has been using both the Hewitt and Fletcher covers for the past seven years, and when made properly has found that the percentage of lost and broken covers was largely in favor of the Hewitt principle. The cost of maintenance is positively less for the Hewitt cover, also the first cost of application. As the question of oil-box covers will be one of the subjects brought up by the rules of interchange revision committee at the next convention it is, no doubt, worth our consideration in the meantime, in order that we may act intelligently.

Member M. C. B. Association.

Behavior of Iron in Solidifying.

A correspondent has written to us questioning the correctness of a statement made by Mr. Whitney, the well-known car wheel maker, at a meeting of the New York Railroad Club, to the effect that molten iron acts like water and expands at the moment of solidifying. As we had not sufficient experience with molten iron to judge regarding the correctness of Mr. Whitney's views, we forwarded the question to Mr. Thomas D. West, the well-known writer on "Foundry Practice," and have received the following reply:

In answer to your question, Does molten iron expand at the moment of solidification? I would say that practically I have never seen it demonstrated. It may be that the molecules of the metal will expand at the moment of solidification; but, taking the body of the casting as a whole, there is no such state existing as "moment of solidification," and practically cannot be seen or shown as it can with ice. With molten or liquid iron cooling two elements of action exist. The first takes place during the cooling of the molten metal to a solid state, and the second from the solidification point to that of its lowest point of temperature or coolness. When molten iron is permitted by form of casting and the mold to have a natural action, it will from the moment the mold is filled or poured till it has reached as a casting its lowest point of temperature, be all the time constantly shrinking and contracting, so as to occupy less space. Liquid metal while cooling to a solid state requires on a average one pound of metal to every 100 pounds to supply its shrinkage or prevent space existing within its body, and its contraction from the solidification point to its lowest temperature will vary from $\frac{1}{16}$ inch to $\frac{1}{8}$ inch per foot. I know that some advocate that molten iron, like unto ice, expands at the moment of solidification, but I have failed to see it proved, and for one would be pleased to see such elements demonstrated or proven to exist.

Piedmont Air Line Rolling Stock.

Only a few years ago the Virginia Midland and other roads that have now been regenerated under the Piedmont Air Line system had the most dilapidated collection of locomotives and cars that were to be seen in the country, and now the rolling stock on this system of roads is noteworthy for its uniformly handsome appearance. The change has been effected in a few years. On the main line of the Richmond & Danville each passenger train is the exact counterpart of the other to an extent to be found on scarcely any other roads. The freight trains are nearly all pulled by standard consolidated engines that look as if each part, from the cast-iron smoke-stack down to the main rod-key, would interchange with those of any other engine, and we believe that this is practically the case.

The company has many old locomotives and cars remaining of the heterogeneous collection inherited with the numerous small roads that were absorbed to make up the present system, but the odd forms and sizes have been placed on the branches, and few but standard types are used on the main line. The standard passenger engine is an eight-wheeler with cylinders 18 × 24 inches, and the driving wheels 66 inches diameter. The total weight in working order is 90,000 pounds, of which 57,000 pounds is on the drivers. The boiler is 54 inches diameter, made of ¼ inch steel, and the fire-box is 72 × 34½ inches. All the engines have Allen-Richardson valves, Detroit lubricators, monitor injectors, consolidation safety valves, and solid ended side rods. All passenger engines have the apparatus to operate the Westinghouse quick-action brake, and the connections for working the compressed air train signal. The boilers are covered with asbestos lagging, and an asbestos board and felt lining covered with Russia iron encases the boiler head.

The standard consolidation stands unusually high in the frame but is said to ride admirably and is not given to toppling over. The unusual height is to admit of a fairly deep fire-box placed above the frames. The cylinders are 20 by 24 inches and the drivers are 50 inches diameter. The weight in working order is 115,000 pounds, of which 99,000 pounds rests on the drivers. The boiler is straight, of Otis steel throughout, ½ inch thick and the diameter at smallest ring is 60 inches. The fire-box is 102 inches long and 42 inches wide. There are 192 flues 2¼ inches diameter. The fittings are much the same as those used on the passenger engines with the capacity necessary for the larger size. The pony truck and tender have Ramapo steel-tired wheels, steel guides and cross-heads of the Laird pattern are used. The engines are noted for the small amount of repairs necessary in proportion to the work done.

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EDITORIAL ANNOUNCEMENTS.

Advertisements.—*Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING COLUMNS. *The editorial department will contain our own views and opinions; and the rest of the reading matter, aside from advertisements, will be such as we consider of interest to our readers.*

Contributions.—*Articles relating to railway rolling stock construction and management, and kindred topics, by those who are practically acquainted with these subjects, are especially desired. Also early notices of changes in railroad officers, organizations and names of companies.*

Special Notice.—*As the* CAR AND LOCOMOTIVE BUILDER *is printed and ready for mailing on the last day of the month, advertisements, correspondence, etc., intended for insertion, must be received not later than the 25th day of each month.*

Wear of Locomotive Tires.

It appears to us that the most important subject under investigation by the various committees of the Railway Master Mechanics' Association is that of "tires, the advantage or otherwise of using thick tires." The circular prepared by the committee having this subject in charge has just been issued, and will be found in another part of this paper. The committee under the lead of Mr. Henry Schlacks are working energetically to obtain the data necessary for a good conclusive report, and it is to be hoped that they will have the cordial aid and co operation of all other members. We understand that the members of the committee are engaged making special investigation with the locomotives under their charge to ascertain the relative merits of thick and of thin tires. This is likely to provide the basis of a good report, and it lies with the other members to supplement the labors of the committee by sending them all the information that can be collected.

Two or three years ago there was a strong tendency manifested among master mechanics to adopt the use of driving wheel tires 4 inches thick or more; but an investigation into the economy of using very thick tires made by the mechanical officers of the Chicago, Burlington & Quincy, the particulars of which were reported by Mr. G. W. Rhodes to the Western Railway Club, indicated that decidedly less mileage per unit of wear was obtained from 4-inch tires than from tires an inch thinner; and since that time there have been few 4-inch tires called for. The question is however by no means settled, and many master mechanics are patiently waiting for further developments before they decide on what standard thickness of tire it is best for their companies to adopt. The committee of the Master Mechanics' Association having the subject of tires on hand has been working on it for two years, and it is earnestly to be hoped that something definite may be learned from the coming report. The report submitted last year showed the evidence of much patient labor and far-seeking research; but it was regarded as being rather unsatisfactory, because no conclusions were reached. We believe that it was impossible for the committee to do anything better than they accomplished, for there were then few 4-inch tires worn out; but the time which has elapsed since the data contained in that report were collected, will be the means of providing much fuller information this year.

The difficulties encountered by those laboring to ascertain the exact wearing qualities of different sizes of tires are very great indeed, much more formidable, in fact, than any one is aware who has not wrestled with the question. Realizing the interest that many of our readers feel in the subject, we addressed letters to the principal master mechanics asking for information as to what they had found out about the comparative wear of thick and thin tires. A large number of replies were received and a synopsis of the information thus collected is published in another page under the caption "Master Mechanics' Views on the Tire Question." The views expressed are well worthy of careful perusal, and we feel assured that few men will rise after reading the article without knowing more about the obstacles in the way of a settlement of the tire question than they did before. While the majority of master mechanics are using tires about three inches thick, it is by no means settled that the majority will be contented to adhere to that dimension. We feel satisfied from what we have found out in studying this tire question that a tire three inches thick is more economical than one an inch thicker, but we admit that there are many good arguments on the other side. One or all of the disturbing elements cited by Mr. John Hickey and others might have intervened to vitiate the data on which we have based our conclusions, but we hardly think that such is the case. The figures quoted by Mr. Hickey to show the increase of tire wear due to the increase of insistant weight upon the driving wheels ought to receive the most serious attention of all concerned. We are inclined to believe that part of the rapid wear due to the heavier engines would be caused by the increase of weight in the wheels and tires themselves. While analyzing the various records of mileage made by different sizes of tires, we found the figures very conflicting; so much so that no general conclusion could be deduced from them. There were some points, however, that appear worthy of consideration. Where thick tires failed to make the same mileage per unit of wear as thin ones, it did not seem to be the rule that thick tires wore more rapidly where the central portion of the tire, which is supposed to be naturally the most spongy, was doing the work. The wear of the first ½ inch was as rapid as the middle part, and the outside of a thick tire ought to be as dense as the outside of a thin one.

It also appeared that switchers and other slow moving engines with small wheels used thick tires to better advantage than fast running engines or those with large driving wheels. These facts would point to the conclusion that the weight of wheel and the rapidity of its revolutions have something to do with the rapid wear of thick tires, the added weight of an extra inch of steel making the hammer that pounds tires and rails to destruction.

While this subject is under investigation, it will not be satisfactorily settled unless it is clearly demonstrated what influence heavy wheels and tires have upon the wear of the abrading surfaces. The tendency of our time is toward driving-wheels of increased diameter. When a cast-iron wheel gets over five feet in size and is encircled by a 3½ or 4-inch tire, there is a very heavy mass of metal hammering over the rails without any spring to soften the rigidity of each blow. We think that the experiment of running one engine with light steel or wrought-iron wheel centers against another of the same general dimensions, and having the usual heavy cast-iron center would teach our railroad men something that would be worth learning.

Different Ways of Wasting Fuel.

The letter in another part of this paper headed "Why do Some Engines Burn More Coal than Others Doing the Same Work?" ought to receive careful study from every man interested in reducing operating expenses. Retrenchment is the order of the day on nearly all railroads at present, most managers taxing their inventive powers to devise the means of making the earnings equal if not greater than the disbursements. This wave of depression comes along pretty regularly and we are gratified to find that the practice of increasing net earnings by reducing the wages of employés, or by letting the operating plant fall into disorder, is falling into desuetude. Cheapened service is always dear in the long run and we feel assured that recuperation will come into action more promptly through the sensible practice of keeping up the zeal and efficiency of the employés. All the men concerned then ought to be anxious to lend their co-operation to reduce unnecessary waste of supplies, and we are certain that material saving of coal bills could be effected by more enlightened handling of the locomotives on most railroads. In the case described by our correspondent, who is a very acute observer, more than half the fuel was wasted through pure mismanagement. In the last annual report of the Chicago & Northwestern, which we have at hand, a road that may be taken as fairly representative of Western practice, the fuel account is over 36 per cent. of the expense of operating the motive power department, and maintaining the motive power department takes 17 per cent. of the gross revenues of the road. From this an idea can readily be formed of the increase of net income that would result from a reduction of 25 per cent. in the fuel account.

Although we have cited the coal expense of a Western road, we do not mean to imply that the possible margin of saving is greater in that region than it is in the East. Quite the contrary. We believe some of the most extravagantly operated locomotives running in this country are at work on railroads east of the lakes.

During the last year there has been an emphatic revival of the demand for more economical use of fuel, but in too many instances the fireman alone is looked to as the instrument of fuel saving. This is a serious mistake. It is very easy for an expert to find cases where firemen, through inferior firing, waste a large percentage of the fuel thrown into the fire-box; but the conclusion we have reached, after extended and vigilant watching of how locomotives are operated, is that the modern fireman does his work much more skillfully and intelligently than the modern locomotive engineer. The letter from "Observer," which we have referred to, gives striking illustrations of the miserable manner in which the feed was operated by the engineer. This was no isolated case either. We know that there are many engineers who follow the practice of shutting off the injector every time the steam is shut off. The practice is based on a sensible theory carried to an absurd length. When there is very little heat from the fire gases passing through the tubes, it is not wise to deluge the boiler with cold water, but to shut the water off altogether when the throttle is closed is to deprive the engine when next started of the reservoir of heat contained in a large volume of heated water. When steam is first shut off, the heat in fire gases is for a short time almost as intense as it was when the engine was working, and the large volume of heat generated is wasted through the safety valves unless it is put into water passed through the check valves. The engineer, who is skillful in his business, and endeavors to work his engine economically, regulates the feeding of his boiler so that he can keep the injector going judiciously when steam is shut off. If there is danger of chilling the boiler he keeps the blower working. When an engine is descending a grade or approaching a station with the steam shut off, it is possible to get the water near the feeding part of the boiler below the boiling point, while the steam pressure remains close to the blowing-off tension. This causes serious internal stresses, and frequently starts the flues leaking; but this injury can be prevented and the circulation of water maintained by keeping the blower working. Because they do not know this, many engineers shut off the feed at the top of a grade, and begin working on the next hill with a limited supply of water in the boiler. Meanwhile the safety valves have wasted steam in descending one grade that might have done an important part of the work of raising the train up the succeeding ascending grade. The same thing happens in approaching stations. The surplus of steam generated when the throttle is closed ought to be stored to help in getting the train into speed after the stop is made.

There are very few road foremen of engines who give proper attention to what we really consider the most important features of an engineer's duties. If the machinery of the engine is neglected, and if brakes or other attachments are badly handled, the road foreman of engines will have something to say about it; but when feeding is badly done, and when no attention is paid to working the steam expansively, these very expensive shortcomings excite little comment.

Inferior firing and injudicious boiler feeding are the cause of great waste of fuel, but we firmly believe that throttling the steam and using it at a low cylinder pressure is responsible for a greater waste of fuel than all the other inflictions of ignorance and prejudice combined. One of the tantalizing things about this way of throwing away fuel is the fact that few officers in charge of the mechanical departments of railroads realize how momentous it is. Men who readily perceive in what way inferior firing is responsible for waste of fuel, appear incapable of appreciating the economical advantage that results from making three pounds of steam do the work that required four pounds under an inferior method of operating. The causes that promote waste of steam are not so readily apparent as those that lead to waste of coal; hence it follows that the importance of handling an engine in such a manner that the nearest possible approach to boiler pressure shall reach the pistons is habitually underrated. We have repeatedly found when indicating locomotives that an engine worked throttling would use double the quantity of steam that was drawn from the boiler when the reverse lever was pulled to the shortest possible point of cut off and the throttle kept open. This to do the same amount of work.

The signs of increased economy to result from locomotive engineers doing their work more skillfully and intelligently are not so encouraging as they ought to be. There is too much labor being bestowed upon the perfecting of contrivances that will enable the engineer to hold the throttle partly closed, and too little attention to making reverse lever quadrants fine enough notched to admit of close variations of the point of cut off. These are straws that indicate the current of our mechanical opinion. Unfortunately the straws are nearly all moving in the wrong direction.

Employes' Insurance of the Burlington System.

The Chicago, Burlington & Quincy Railroad Company have followed the example of a few other large railroad corporations and established an insurance organization for the employés of the company. Membership is voluntary, no employé being required to join the association, and any member can withdraw from the department at the end of any month. Offices will be furnished by the Burlington system, which will also donate the services of its clerks, pay for printing, stationery, salaries of its clerks, medical examiners and all incidentals, which will amount to some $60,000 a year. The company will take charge of the funds, guaranteeing their safe keeping and proper disbursement, beside paying interest on monthly balances in its hands at the rate of 4 per cent. per annum. It will also guarantee the payment of benefits so that in case the contributions of members are not sufficient to meet the disbursements the company will advance the money for the payment of benefits as they become due. At the end of three years if any deficiency shall exist it will be supplied by the company. For the first six months employés will be admitted to membership

without regard to age and without passing a medical examination. After the first six months, however, no employé over 45 years of age will be admitted, and each applicant will have to pass a satisfactory medical examination. Employés are divided into five classes, as follows: Those receiving wages of $40 per month or less, those receiving over $40 and under $60, those receiving from $60 to $80, those receiving from $80 to $100 and those receiving $100 or more. The contributions vary from 75 cents to $3.75 a month, according to the class. The benefits which members are entitled to receive vary from 50 cents to $2.50 per day, according to class. In case of accident in the service the member is entitled to benefits at full rates for fifty-two weeks during disability and at half rates thereafter, and receives surgical attendance as long as necessary. In case of accident while off duty, the injured member is entitled to receive the full rate for fifty-two weeks. The death benefits vary from $250 to $1,250. In case of sickness or accident terminating fatally, the death benefit is paid in full, no deduction being made for benefits paid during sickness or disability during accident.

This looks like an arrangement calculated to be of very great benefit to the employés, yet it is doubtful if the organization will receive the support that might be anticipated. American railroad employés have always looked with suspicion upon benevolent schemes originated by the companies for their benefit. There is constantly a fear, which is not always unfounded, that a claw of self-interest is concealed behind the velvet paw of benevolence. While it is of decided advantage for a railroad company to have its employés bound to itself closer than the chain formed by the selling and buying of labor, it does not follow that the additional bonds will chafe the employé more than it does the employer. The railroad labor disputes of the last few years have convinced us that it would be to the ulterior benefit of employés themselves to have bonds which would make them a little less ready to submit with unquestioning obedience to the behests of grievance committees and other agitating agencies. Entering into a mutual benefit compact with a railroad company gives an employé an increased interest in the company's welfare, and they are wise managers who can make a compact of the kind with the majority of their men.

The controlling aim of competent railroad managers in establishing insurance associations for the benefit of their employés is undoubtedly to further the interests of the companies; but the cases are very exceptional where the benefits are not mutual. The insurance offered by the Burlington system will certainly be a valuable boon to the non-union engineers and firemen, and will give them the real benefits of a brotherhood without its many drawbacks.

Captain John Ericsson.

Captain John Ericsson, one of the most famous engineers and inventors that the world has ever seen, died in New York on March 8 in the 85th year of his age. Captain Ericsson is best known to Americans as the designer of the revolving turret iron-clad "Monitor" which successfully fought the Merrimac in Hampton Roads, and was the means of revolutionizing the navies of the world. Yet his successful labors in designing appliances for developing the peaceful arts, gave him much greater claim upon the gratitude of mankind, and it is by no means creditable to his adopted countrymen that the achievements of Ericsson are so little known outside of the engineering world.

John Ericsson was born in Sweden July 21, 1803, and from his early youth manifested extraordinarily powerful inventive faculties. At the age of 12 he entered the Swedish army as a cadet, and was employed the greater part of his time on engineering duties. In 1826 he was promoted to a captaincy, and in the same year he resigned from the army, and proceeded to England, where his engineering and inventive abilities were likely to have a better field than the limited industries of his native land afforded. During the years of his stay in England, he invented several useful devices that are still in common use, but the product of his genius at that period, which mostly interests railroad men, was his designing and building of a locomotive engine which competed with Stephenson's "Rocket" in the famous trials at Rainhill on the Liverpool & Manchester Railway in 1829, where the speed capabilities of a locomotive engine were first properly demonstrated. This engine was called the "Novelty," and was the popular favorite. It had an upright boiler on one end of the carrying frame, and the cylinders, tank, a water heater and bellows for maintaining artificial draft were well distributed on the other part. The power was transmitted to a cranked axle. The engine attained a speed of 28 miles an hour, but the bellows for stimulating the fire failed at a critical time, leaving Stephenson's Rocket the victor. This event appeared to have closed Captain Ericsson's connection with railway machinery.

He came to America in 1839, and during the fifty years spent in this, his adopted country, he has constantly marched in the van leading engineering progress. His inventions and improvements have been so numerous that t would take pages merely to mention them. Those for which he is best known are the submerged screw propeller and the caloric engine.

Many honors have been bestowed upon Capt. Ericsson by various governments and scientific societies. The second bestowal of the Rumford medal was awarded to him by the American Academy of Arts and Sciences. He received the thanks of Congress, and was a member of many scientific societies.

The Best Way to Handle a Locomotive.

In our correspondence columns, we publish a letter from H. Kingsland, a locomotive engineer, giving his opinion that regulating the admission of steam by the use of the throttle is the proper way to run a locomotive. Our correspondent, although an old hand in the business, never heard of an engineer who considered running with a full throttle was the proper way to work a locomotive. In the letter he emphasizes two stock arguments used by locomotive runners against the practice of running with an open throttle. The first is that the pressure on the slide valves is so great that the reverse lever cannot be safely handled; the second is, that when the lever is pulled near the center notch and the throttle opened wide, the engine acts as if working against herself.

Although Mr. Kingsland has not found a fellow-runner favoring the practice of running with the throttle full open, we are in a position to know that the practice is quite common on many roads, and is extending as a generation of engineers grow up who are more familiar with steam matters than their predecessors have been. When engineers follow the practice of running with the throttle full open, they do their work intelligently and judiciously, and there is no need for their having a throttle that must be either full open or shut, as our correspondent satirically suggests might be introduced. The difference in the economical working of a locomotive that has the steam regulated by the throttle, and in one that has the admission to the cylinders regulated by the slide valve, is about the same as the difference between a common slide valve throttling engine and one with automatic cut off.

In our issue of March, 1888, we published a communication from the most intelligent engineer of our acquaintance, in which the account was given of a most remarkable record of fuel saving effected principally by working the engine, so that the full benefit was derived from the expansive force of the steam used. This practice made an average difference of 37½ per cent. in favor of intelligent handling. On the Fort Wayne divisions of the Pennsylvania railroad, certain old engineers who believed in lightening the pressure on their slide values by running with the throttle partly closed, were not able to make a long first run without stopping at a water station which was seldom used by younger runners. The master mechanic insisted that these men who were so solicitous about their valve seats should cease stopping at the water station or give up their engines, and this was reluctantly accomplished by adopting the practice of running with an open throttle. Many other cases of the same kind could be given.

There are some engines we admit that cannot be worked closely hooked up owing to the great compression they develop, which makes the engine act as if she were working against herself. This is a fault of design, and is most common with locomotives having the ports too short. When a capable engineer is handling a locomotive of this kind, he places the lever in the notch where the most satisfactory work can be got. That some engines are designed so that they must be worked in a way which wastes steam, is no argument for working good engines in the same fashion.

The Strike Sequel.

The most unfortunately situated body of men that we know of to-day are the engineers and firemen who, at the order of sinister leaders, left their engines on the Chicago, Burlington & Quincy system thirteen months ago. When the so-called settlement of the strike was effected last January, it was supposed by many of those most directly interested that the greater part of the men would be restored to their old places, but so far none of them have been taken back, and there is now a fierce disposition manifest to put the blame for the failure of the strike upon some one's shoulders. The firemen stood firmly by the engineers with unparalleled fidelity throughout the strike, but their representatives received small courtesy when the engineers determined to declare the strike off. This has aroused animosity and bad feeling, and the men who were responsible for originating and protracting the strike beyond the period of compromise are trying to make out, by direct charge or insinuation, that the committee which effected the final settlement were guilty of selling out the strikers. This assertion is in a line with the way the whole business of the striking enginemen has been managed. Every man not blinded by hot-headed prejudice or who was not financially interested in maintaining the struggle, knew the case of the men was hopeless a month after the strike was inaugurated, and the men who did most to keep up the conflict are well aware that nothing of a cause remained to be sold out.

During a recent visit to the West we met quite a number of the strikers, and found many of them talking very bitterly about the treatment they have received from the Brotherhood. There is a scheme on hand among the men to go and form a farming colony in Dakota or Montana. That is a very sorrowful last resort for a mechanical man, and is likely to lead to further disappointment. One of the saddest sights to be seen in Europe after the fall of the first Napoleon was the spectacle of old soldiers of the guard following the plow. An old engineer at the plow is hardly less pathetic or out of place. His railroad training unfits him for the monotonous life of a farm and invites failure. Many of the best men who took the places of the strikers on the "Q" system were enginemen who had become farmers, and became tired of the eventless calling. The result of the great number of enginemen who have lost their places on the "Q" going into other occupations will long be a menace to the brotherhood in case of any future strike.

A Personal Matter.

In writing from time to time concerning the strike of enginemen on the Chicago, Burlington & Quincy Railroad, we have striven to tell plainly what we thought about the malignant part Chairman Hoge had played in that affair, where he certainly was the high priest who led the enginemen to the sacrifice of good positions. We have said, and we still believe, that Hoge used his influence to protract the settlement of the strike to suit his own purposes, and in public and private we denounced the author of the infamous sal soda and emery secret circular sent out from Hoge's headquarters. Early in March the editor of this paper happened to be in Chicago, and he met Hoge in the rotunda of the Grand Pacific Hotel, when a rather exciting interview took place. Hoge protested that he was not the author of the sal soda and emery circular, that it emanated from a high officer of the brotherhood. Then he waxed wroth at what he called the abuse we had been giving him, and behaved very much like the elderly naval man in "The Yarn of the Nancy Bell," who "shook his fists and tore his hair." As the said Hoge is built with the diameter of a fat donkey and the altitude of a mature giraffe, while ye editor is put up on a diminutive scale, the friends of the latter who witnessed the meeting feared that he might get crushed if the excited tower of lard should happen to fall upon him. Events looked rather sanguinary for a time, but after informing us that if ever we mentioned him disrespectfully in the paper again, he would follow us to New York and assault, pound and otherwise grievously maltreat us, Mr. Hoge took his departure and so peace was restored. Hoge is still one of the influential members of the Brotherhood of Locomotive Engineers, and can afford to live in first-class hotels, while the majority of his dupes are finding it almost a hopeless struggle to obtain the bare necessaries of life for their families.

The Pennsylvania Railroad Company are building new shops at Altoona to be used exclusively for building new locomotives. The shops are going to be equipped with the best kind of machinery designed for the production of locomotive parts, and the master mechanics of the system have been consulted on the arrangement and equipment of the works. The Pennsylvania Company have long followed the practice of building a great many of the locomotives used on the system, but it is no secret that the same engines could generally be bought cheaper from contract firms. The fact that a company can put money into a plant for building locomotives and make the equipment as nearly perfect as possible, does nothing towards proving that the machines could not be bought for less from the manufacturing establishments that follow the business of locomotive building, and whose very existence is dependent on the work being turned out at the least possible cost. Competition is so keen in the building of all lines of railroad rolling stock nowadays that prices seldom go much above cost of production and never to a scale that admits of a big margin of profit. Owing to this, a railroad company must have an exceptionally well-organized system of production to do their work more cheaply than the articles needed can be bought. We have not heard that the Pennsylvania contemplate building their own shop tools; but there is as much likelihood that they could do so economically as that, they could build their locomotives more cheaply than they can buy them from manufacturers.

For some years a syndicate of French capitalists, under the name of the Société des Métaux, has controlled the copper markets of the world, and compelled users to pay exorbitant prices for the metal they were compelled to buy. Copper has seldom been less than 50 per cent. above its natural price. Railroad companies having to use large quantities of copper for bearings and other purposes were heavily taxed by the monopoly. To all who have been paying fancy prices for copper, it will be good news to hear that the syndicate has failed, and that their control of the market has been broken. The likelihood is that copper will now come down to its natural level.

Amendments to the Inter-state Commerce Law.

Towards the closing days of last session Congress passed some very important amendments to the Inter-state Commerce Law. It is now made illegal for railroad officers to reduce a tariff without giving three days' public notice. In cases of flagrant discrimination, officials are subject to the penalty of imprisonment, besides a heavy fine. Shippers, as well as railroad agents, are held liable for false description of goods, and it is made a criminal offense to give a railroad agent pecuniary inducements to violate the law.

Since these amendments became law, we have discussed them with a number of railroad managers and find that great satisfaction exists on account of the change. Every one spoken with wished that the time of notice of reduction of rates had been made longer ; but all expressed themselves as being satisfied that decided improvement in the maintenance of rates would result. Some of them favored the requiring of ten days' notice to make the reduction of a tariff legal, and others thought that thirty days would not be too long. They all appeared to think that a change for the longer period of notice would be passed at some time in the near future. No one had anything to say against making discrimination a criminal offense ; but we understand that certain freight agents are roundly abusing the law. Putting the extreme penalty of the law upon a few freight agents would, we feel certain, have a most beneficent effect upon their rivals. We will be very much mistaken if some of them do not earn the full penalty.

Mr. Charles F. Adams, president of the Union Pacific, has contributed to *Scribner's Magazine* an article on "How to Prevent Railroad Strikes." The remedies suggested are principally in the line of laboring to promote closer and more harmonious relations between managements and the employés. He recommends certain methods of treatment. First, that the classes of railway employés most important to be considered in connection with strikes are those who are identified with operating departments. Second, that these are naturally divided into two classes, one being temporary and the other permanent, and that the process of transfer from the first of these divisions to the second should be utilized in a manner that would materially increase the reliability of those who permanently enter the service of important companies. Third, that the latter class of employés should be secured against discharge except for amply sufficient cause, and given full opportunities for self-defense against any charges that may be preferred. Fourth, that the harmony of relations between each company and its permanent employés should be promoted in sundry ways which are specified. They include the establishment of hospital funds, retiring pensions, and insurance associations ; provision for the education of children of employés in branches that would specially qualify them for railway service ; and the organization of boards that would materially improve existing methods for consultation between managers or directors of railway companies and each class of employés in reference to all questions that grow out of their mutual relations.

The masterly article on the "Inconveniences of the Metric system," by Dr. Coleman Sellers, that will be found in another page of this paper, is an admirable exposition of the annoyance and expense that would follow in all lines of business were the attempt seriously undertaken to force the French system of weights and measures upon our people. If the article by Mr. George M. Bond that appeared in last month's issue has left any master car-builder or railroad officer with the faintest hankering after the so called "uniformity" of the French system, we commend to his attention the mental alterative which will be found in Dr. Sellers' article. The writer is no mere theorist. He has probably seen and studied more of the practical working of the metric system as applied to shop work than any other engineer in America, for it has long been used in the injector-making department of William Sellers & Co., and it was because the system proved more inconvenient in every way than the metrology based on divisions of the inch that Dr. Sellers gradually became opposed to its general introduction. After what has been written there is no fear of any railroad officer attempting to introduce the French system of measurement into his shops, and we consider that railroad companies are indebted to Dr. Sellers for shielding them from the great expense that an experiment of the kind would have entailed.

Combustion in Locomotive Fire Boxes

The pamphlet which we have issued on the above subject, prepared for the use of enginemen by Angus Sinclair, is greatly in demand by railroad companies. During the two months the treatise has been on the market, over ten thousand copies have been purchased by railroad companies to be presented to their train men. The Southern Pacific Company alone ordered two thousand copies, the Union Pacific sixteen hundred, and several other companies ordered each about one thousand copies. Among the companies which have supplied the book to their men are the New York, Lake Erie & Western; New York, Ontario & Western; New York, Providence & Boston; Wisconsin Central; St. Paul & Duluth; Kansas City, Fort Scott & Memphis; Lake Shore & Michigan Southern; Philadelphia & Reading; Burlington, Cedar Rapids & Northern; Denver & Rio Grande; Allegheny Valley; Minneapolis, St. Paul & Sault Ste. Marie; Northern Pacific; Southern Pacific, and Union Pacific. The officers of several of the roads named say that the men express themselves as being interested in the teaching of the pamphlet, and the general opinion is that its circulation will prove a very good investment for the companies through the certain saving of coal that will result from the men receiving instruction relating to the principles of combustion.

The *Railroad Gazette*, New York, has published a very convenient and useful time, expense and memorandum account book for the use of engineers and firemen. The book is ruled, giving a column for each day of each month in the year, and opposite to the columns are spaces for the names of places to and from which runs are made, the different kinds of trains being distinguished. There are also lines for noting down time used up in waiting, switching, wrecking, construction, etc. In addition to these the book contains a calendar and leaves for noting down expenses. The engineers and firemen who use this book for keeping their time and mileage, will hold in their hands a constant and convincing check against the mistakes so regularly made by time clerks. The book is of convenient size for carrying in the pocket, and costs only 50 cents.

Personal.

Mr. J. A. Barnard, son of President Barnard, of the Ohio & Mississippi, has been appointed purchasing agent of that road.

Mr. A. M. Wellington, editor of the *Engineering News*. New York, has been elected a member of the Institution of Civil Engineers, England.

Mr. Theodore N. Ely, general superintendent of motive power, Pennsylvania Railroad, was recently elected a member of the Institution of Civil Engineers, England.

Mr. J. T. Odell has, it is understood, resigned his position as general manager of the Chesapeake & Ohio to become manager of a large Southern car-building company.

Mr. A. R. Cavner, the chairman of the committee that settled the Burlington strike, has accepted an engagement with Leonard & Ellis, valvoline manufacturers, as traveling agent.

Mr. George F. Wilson, who has left the Minneapolis & St. Louis to become assistant general master mechanic of the Chicago, Kansas & Nebraska, was considered one of the ablest mechanical men in the northwest. It is said that President Cable of the Rock Island system appreciates Mr. Wilson's worth.

Mr. Charles Blackwell has resigned the position of engineer of machinery of the Central Georgia Railroad. Mr. Blackwell is a thoroughly educated engineer and a very progressive railroad mechanic, and his services will be of great value to any railroad manager who wants to see his mechanical department intelligently supervised.

George H. Daniels, vice chairman of the Central Traffic Association and chairman of the East-bound Passenger Committee, has been appointed general passenger agent of the New York Central Railroad. He is 47 years old, and has been in the railroad business for thirty-one years, starting as a flagman on the North Missouri Railroad.

As will be seen from our directory notices, Mr. J. T. Harahan, for a short time assistant general manager of the Lake Shore & Michigan Southern, has been appointed general manager of the Chesapeake & Ohio, with headquarters at Cincinnati, O. Mr. Harahan is highly popular with the men under him, and we are glad to see him go to the top where he belongs.

In the course of last financial year, the Cleveland, Columbus, Cincinnati & Indianapolis built 125 stock cars in their shops at Cleveland, and they expect to build 50 more this season. They have 1,000 box cars and 100 stock cars now under construction in contract shops. They are putting air brakes and close couplers on all stock cars. They expect to order some new passenger cars this season and they need a good many new tools for their shops at different points, which will likely be granted. They are getting six new engines built at Schenectady, 3 eight-wheel passenger and 3 six-wheel switchers. The passenger engines will have cylinders 18 × 24 inches, wheels 60-inch centers, boiler 54 inch shell, fire-box 78 inches long between frames. The switchers will have cylinders 17 × 24 inches, wheel center 44 inches and boiler shell 50 inches.

The Wagner Palace Car Company will soon have ready for service eight sleeping cars for the New York Central to be run on the limited express between New York and Chicago. Four of the cars will contain sixteen sections or thirty-two double berths. The other four are designed to accommodate families or parties desiring privacy and seclusion, each car being fitted up with ten apartments with two berths, lavatory, closet, etc. The apartments have doors leading into the main aisle and are provided with folding doors which can be opened, thus making one room of two apartments. The cars are richly decorated and handsomely furnished and are provided with all the modern appliances for convenience and luxury.

Trial of Boyden Brake.

The Boyden Power-Brake Company took a party of gentlemen yesterday on a trip to witness the performance of their new brake as applied to passenger cars. The brake has heretofore been tried successfully on freight cars, and is now in use on the B. & O. road. The train yesterday left Camden Station at about 10:30 A. M., and consisted of locomotive, tender and four cars, all fitted out with the Boyden automatic brake. The railroad company will hereafter run the same train daily between Baltimore and Frederick. The track, owing to the snow that fell the day before, was in an unfavorable condition, but the stops were very good. One was made at Annapolis junction, while running at forty miles per hour, within 180 feet. This was considered a remarkable stop. The action of the brake in graduating—that is, to merely hold a train in check—is very satisfactory, and when the train comes to a full stop there is no shock or rebound. The brake releases quickly and applies simultaneously on all the cars. The Boyden brake will work well in a train equipped with the Westinghouse brake, the two kinds of brakes being made to apply by the same reduction of pressure in the train pipe. Among the gentlemen in the party yesterday were: German H. A. Hunt, Richard Cromwell, E. G. Hite, Geo. F. Sloan, John A. Robb, J. T. Woodside R. J. Hollingsworth, J. H. Cottman, Douglass H. Thomas, A. A. Bressee, Wm. A. Marburg, Theodore G. Lurman, Clarence Jackson, A. C, N. Matthews, Wm. Reed, Colin Stewart, Dr. Wm. Whitridge, Charles B. Mann, Geo. B. Jackson, Josiah Pennington, R. Brent Keyser, John L. Bigham, Munro Snell and Geo. A. Boyden, the inventor of the brake. The brake company have started their shops in Holiday Street, and are now turning out the various parts of their brake, for which they have orders, ahead.—*Baltimore American.*

William White & Co., Moline, Ill., makers of the automatic coal chute for coaling locomotives, and of the "bulldozer" forging, forming and bending machine, have issued a memorandum book for their patrons illustrating their specialties.

The Brady Metal Company has been formed, Mr. Daniel M. Brady being president and Mr. James B. Brady vice-president. The company will manufacture car and locomotive bearings, and babbitt metal of every grade. The office of the company is in Boreel Building, New York.

Mr. J. D. Vail, Blairstown, N. J., has invented an automatic lock and indicator for water-closets, which would be a convenience if placed on the doors of the saloon on passenger cars. When the bolt is turned inside a notice is presented outside indicating "occupied." Withdrawing the bolt changes the notice to "vacant."

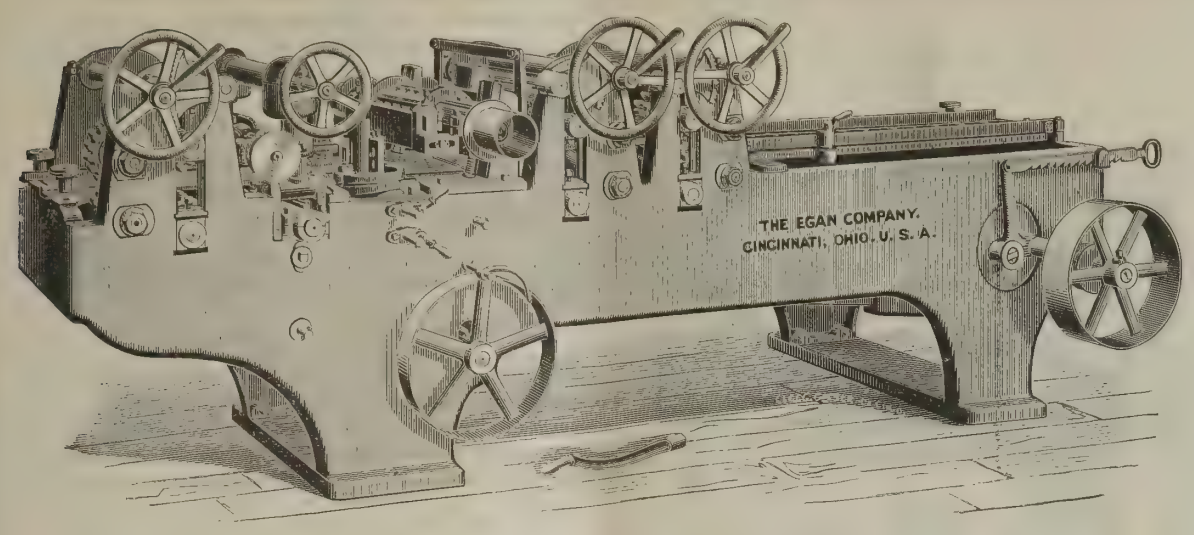
Gould & Eberhardt have been awarded the contract for furnishing the Navy Department, at Washington, D. C., with one Eberhardt Entirely Automatic Gear Cutter. Although a number of the best competitors were in the field, this Newark firm got the contract by merit of construction, as they were the third from the lowest in price.

The Tiffany Refrigerator Company have lately put 200 of their cars upon the Atchison, Topeka & Santa Fe, to be used mostly for carrying fruit from California. They have also supplied 100 cars to the Kansas City, Memphis & Birmingham. The Lafayette Car Works are building 63 Tiffany refrigerator cars for the Illinois Central Railroad.

One of the most artistically illustrated catalogues that we have seen lately has been published by the Gould's Manufacturing Company, Seneca Falls, N. Y. The specialty of this company is pumps and they are to be found shown in the greatest variety, and many of the scenes where the pump is a figure are introduced. The catalogue is an interesting study for any one who likes to examine fine-art productions.

J. M. Foster, 145 Broadway, New York, recently furnished one of his 10-inch pressure regulators to the Cincinnati Water-Works, and now has an order for one of the same size for the water-works at Asheville, N. C. The Baldwin Locomotive Works are applying the Foster steam pressure regulators to a number of locomotives being constructed by them, and the Pennsylvania Company have ordered a large number of the regulators to be sent to their Allegheny and Fort Wayne shops, and the P. W. & B. are also applying them to their locomotives.

The Marden Car Brake Company, of Boston, Mass., are meeting with great success with their car brake beam. They are at present filling an order for 2,000 brake beams for a Western railway, and have them on a number of Eastern railways. They have recently purchased about 500 tons of steel from the Cambria Iron Company, but from the number of orders they are receiving that quantity will not last very long. Mr. Samuel T. Rowley, formerly connected with the Congdon Brake Shoe Company, has been appointed their Western agent, with office at 147 Van Buren street, Chicago, Ill.



NEW FAST FEED FLOORING MACHINE.

We illustrate herewith a new improved fast-feed flooring machine, which has been designed especially for fast work and quick adjustments. There is a demand for a machine that is simple of operation and easy of adjustment, one that is able to stand up to any kind of work, such as flooring, patent siding, beaded ceiling, moldings and work of that class, doing it perfectly and reliably. Such a machine is presented to the trade at a very moderate price.

The frame is made upon the most improved plan, being curved and heavily ribbed on the inside, and all parts planed, and when bolted together make a very strong and well-braced frame, capable of withstanding any amount of strain that may be put to it.

The cutting cylinders are made of the best quality of steel and slotted on all four sides, each side having a knife. The journals are very long, of large diameter and revolve in self-oiling boxes, which are lined with the best genuine metal.

The feed consists of six 7-inch feed rolls, all heavily geared. The system of gearing on this machine is entirely new and consists of all the rolls being driven by internal and external gearing, without expansion links; each upper feed roll is made to lift parallel, thus giving a full and even pressure across the surface of the board; this is effected by a new and ingenious device for raising and lowering the upper rolls, which can be done instantly to accommodate the thickness of stock; each roll is furnished with an improved scraper to keep it free from gum. The two upper front feed rolls are held down by our new weighted equalizing bar, allowing ample lifting range to suit unequal stock.

The patent pressure bars are of the most improved design, and are made to adjust in and out on each side of the cutting cylinder, giving the machine all the advantages of an inside molder, and enabling the operator to do the very smoothest of work.

The matcher spindles run in long-connected bearings, and the matcher hangers have separate adjusting screw and locking device, to allow for width of stock to be cut, and to insure equal wear on the bed. Adjustable hold-down brackets are provided to hold the stock firmly while matching is being done. The bed plate is made to take out, for the purpose of truing up when necessary.

The independent beader and pressure bar for the lower cylinder, are on the most improved plan, and can be swung out of the way by simply taking out one pin, if the operator wishes to look at or sharpen the knives.

The builders especially recommend this machine to all planing mills, large or medium size, where a first-class machine is wanted for general work, on account of its quick adjustment and its simplicity of construction, capable of standing up to the hardest kind of work.

Two sizes of this machine are made to work nine inches wide and fourteen inches wide respectively, and to work either three or four sides.

For further information address the builders, the Egan Company, Nos. 235 to 255 West Front street, Cincinnati, O.

Automatic Seal Lock.

The automatic seal lock for freight cars, mail bags, express boxes, etc., is the invention of Eduard Meise, Pittsburgh. It consists of a cast-iron or steel body part or hasp, one arm being enlarged and bored out to receive a steel locking apparatus which rotates in one direction only. The other arm has a longitudinal slot extending in the direction of the bow.

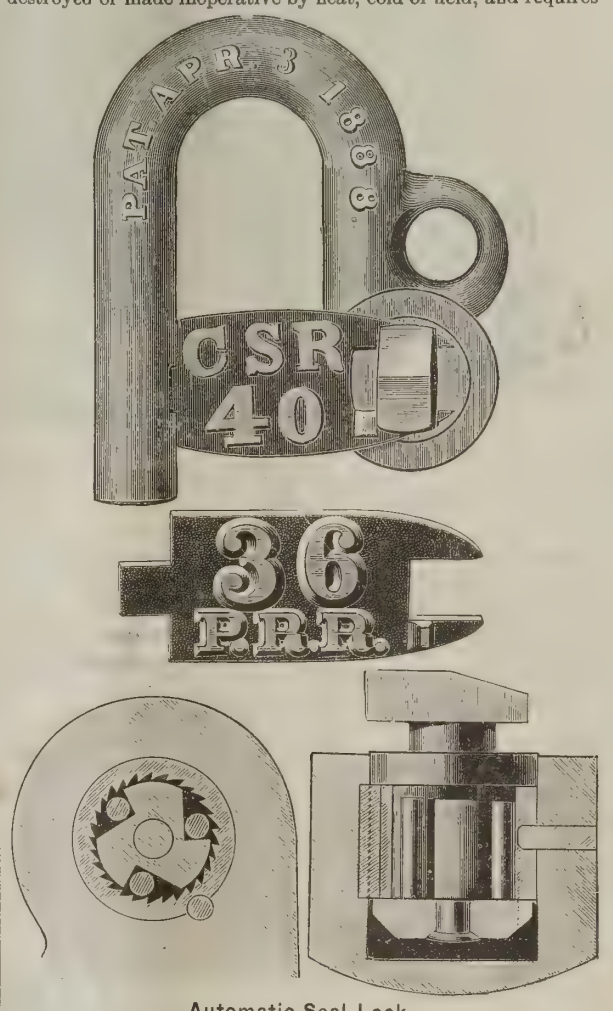
The arms of bow or hasp are connected by a frangible cast-iron seal plate, provided with a stop lug on its upper surface, and bearing name of railroad and number of station. One end is provided with a lip which is inserted in longitudinal slot in one arm of bow; the other or forked end of seal plate drops over locking block in opposite arm.

Turning locking block one-fourth turn, it engages with stop lug on seal plate, and the lock is securely sealed, while to open the lock it is only necessary to break the connecting plate.

The locking apparatus consists of a block turning within a sleeve, the inner surface of which is longitudinally corrugated. The shaft or journal portion of the block fitting with in the sleeve is cut away on one side to form the cam face with the shoulder, and a cylindrical pin fits within the space so formed between the bearing and block shaft journal. This pin rests against the shoulder when the block is turned in one direction, and permits the block to be turned in the sleeve. On attempting to turn the block in the opposite direction, the pin is forced by the cam face against the interior of the bearing and jammed between the bearing and block journal. This prevents the turning of the block, the corrugated interior surface of bearing assisting in holding the pin and preventing its slipping around within the bearing.

It is claimed that this seal lock has the following advantages:

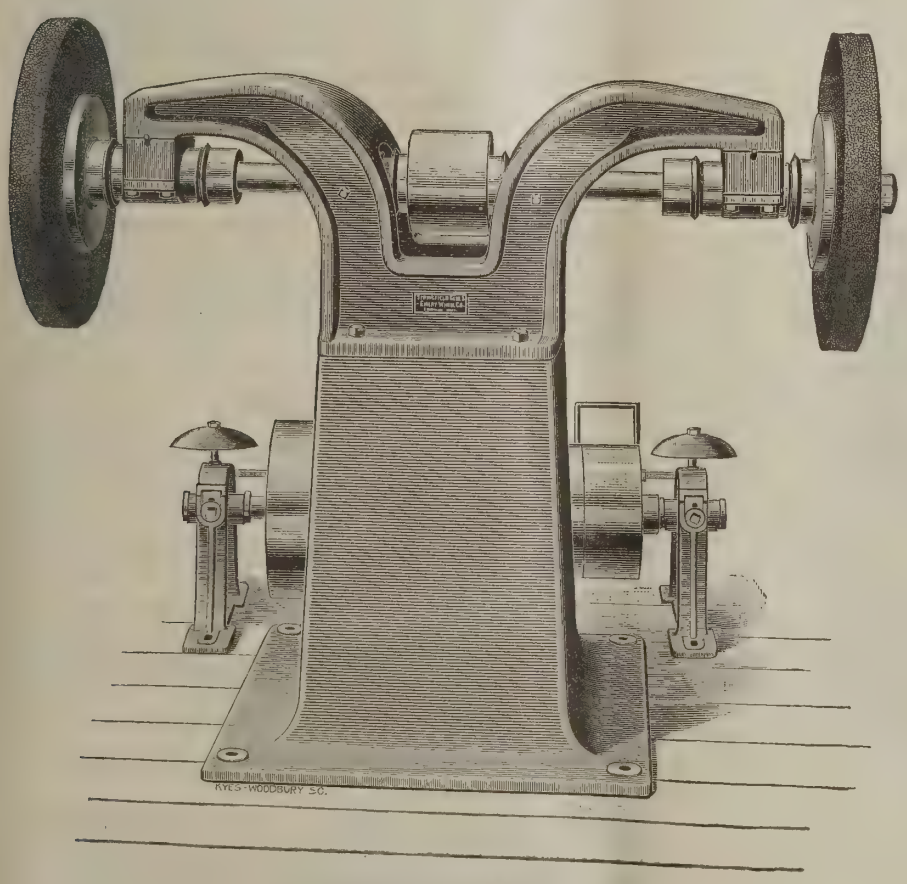
The lock contains no spring, wire, lead or glass to be readily destroyed or made inoperative by heat, cold or acid, and requires



Automatic Seal Lock.

no tools or presses to seal. The seal plate is always in sight and name of railroad and number of station is sufficiently large to allow of name and number being inspected while the train is in motion. This lock cannot be carelessly sealed, as turning locking block sufficient to keep seal plate from jarring off in transit makes it impossible to remove seal plate intact. It cannot be tampered with without detection; when once locked it cannot be opened without breaking seal plate or lock. The lock is chained to the car and allows the opening of doors for ventilation, at the same time being securely sealed, and is adapted to all kinds of car doors without requiring any change in their construction. When not used as a seal the lock can be used as a pin to place through staple. An appreciable saving of time is made in sealing. This lock also permits the adoption of a suitable inspection tag, which adds very little to the expense.

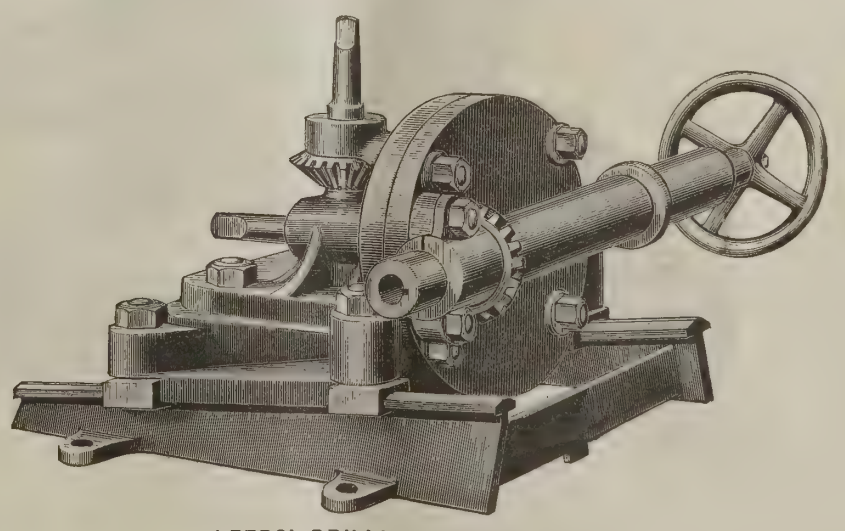
Any further information or sample of lock for inspection may be obtained of the makers, the Automatic Seal Lock Co., Pittsburgh, Pa.



SURFACE GRINDER.

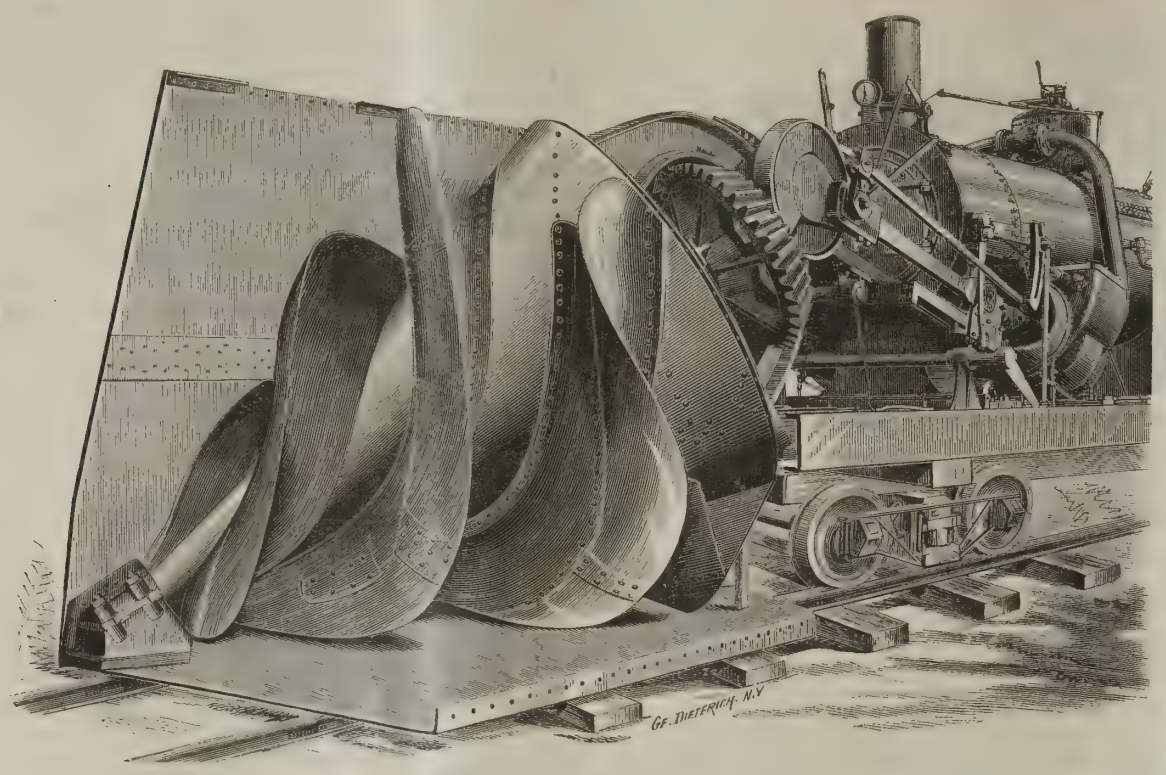
This machine is especially adapted for grinding and polishing castings that are so heavy that it is necessary to handle them on a truck. It is made with a very heavy square base, with sufficient spread to stand firmly on the floor and prevent vibration when being used. The arbor is made long, giving a good clearance to handle work. It has four bearings, so as to run steady without vibration. The weight without wheels is 1,600 pounds; height from floor to center of spindle, 42 inches; height of base, 30 inches; length of two outside bearings, 8 inches, and are self oiling. Length of two inside bearings, 6 inches, located each side of pulleys. These are not shown in cut. Diameter of spindle in bearings, 2¼ inches; diameter of spindle where wheel goes on, 2 inches; distance between wheels, 60 inches; distance spindle extends beyond frame leaving clear space, 21 inches; entire length of spindle, 71 inches; spindle pulley, 8 × 6 inches; carries two wheels any size up to 30 inches diameter; floor space of base, 34 × 34 inches; driving pulley on countershaft, 20 × 6 inches. This grinder is made by the Springfield Glue and Emery Wheel Company, of Springfield, Mass.

Owing to the constanly increasing demand for the cordage manufactured by the Samson Cordage Works, of Boston, Mass., they have been compelled to increase their facilities for manufacturing it, and have removed their factory to Shirley, Mass., where it covers a space of 32,000 square feet. They make their own yarns,



LEEDS' DRILLING ATTACHMENT.

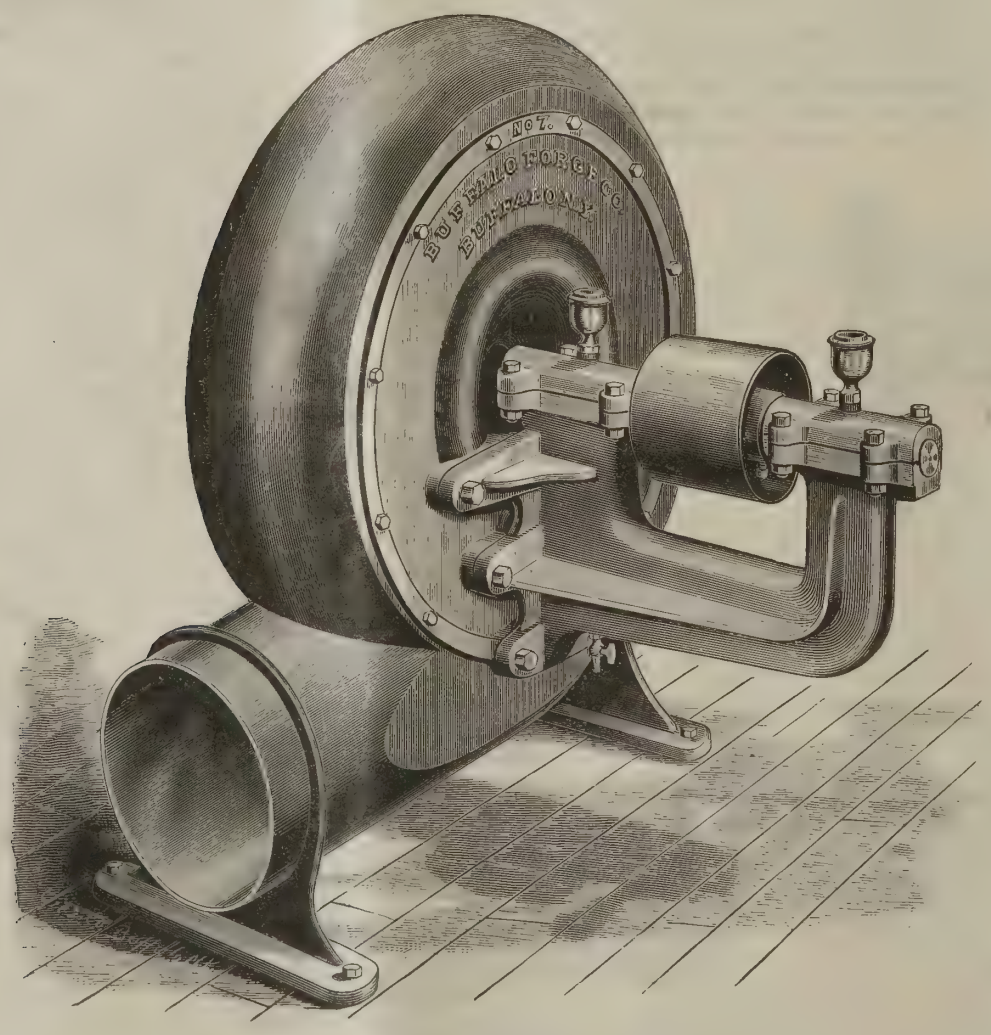
This machine is designed to work on or from a drill press. It is mounted on the frame and is driven direct from the drill-press spindle. It is useful in drilling the ends and diagonal parts of frames, it can also be mounted on the work and driven by a sliding shaft and universal joints. Drilling in all directions can be done with the two (2) taper shanks and the horizontal and vertical movements, by loosening the nuts shown. This machine does away with the expensive ratchet worked by hand, and it is capable of drilling with as great speed as though drilled direct. The spindle is drilled for Morse taper sockets. This machine is the invention of Mr. P. Leeds, M. M., Louisville & Nashville R. R. Co., and he is using it very generally and successfully in his work. It is sold by Pedrick & Ayer, Philadelphia.



JULL CENTRIFUGAL SNOW EXCAVATOR.

The annexed engraving represents the Jull centrifugal snow excavator, a machine built lately by the Southwark Foundry and Machine Company, Philadelphia. This machine is the first of the kind made, and it is a very substantial piece of mechanism. The whole thing in working order weighs 65 tons, and is 42 feet long. The bladed cone in front, which excavates the snow and throws it away from the track, is made of ⅝-inch plate steel, and weighs six tons. This cone, as may be seen by the cut, is arranged diagonally across the front of the frame with the apex at the lower right-hand corner of the hood, which is pushed into the snow. The blades secured to the cone are curved, and form a spiral that increases in diameter as the cone widens, and is so set that when revolving it works like a huge auger cutting out a slice in a snow bank equal to the surface presented, and delivering the snow at the base of the cone, which is on the top of the machine, and sending it with a high velocity into the country adjoining the track.

That is the theory of the action of the excavator's mechanism, and it was reduced to practice in some trials made in deep snow-banks, on the Rome, Watertown & Ogdensburg Railroad. It cut through a snow-bank 7 feet deep and 720 feet long in seven minutes, cutting the snow out at the rate of 7,200 cubic feet per minute, when driven at 180 revolutions per minute. The proprietors say that the machine can be safely run at the rate of 300 revolutions per minute. A pair of cylinders 18 × 24 inches are used for driving the cone to which they connect by heavy gearing. A large boiler is carried of sufficient capacity to supply steam to the cylinders should they be kept working constantly at their full power. Mr. George H. Hobart is president of the Jull Centrifugal Snow Excavator Company.



THE BUFFALO EXHAUST FAN.

We illustrate herewith a new exhaust fan which possesses several distinguishing features. Prominent among them is the solid case, the peripheral portion of the shell or case being cast in one solid piece, to which the center plates are accurately fitted, metal to metal, without the interposition of any foreign substance whatever.

It is claimed as the result of this manner of construction that the fan is practically one piece, and that under any service the bearings must always be in perfect alignment vertically and laterally with the rest of the machine.

The journals are long and heavy, supported by an arm having planed surface fitted accurately to the body of the fan. By a perfect system of gauges and templates it is claimed the different parts of the fan are so well proportioned and fitted each to the other that at the highest speed there is practically no vibration. Both bearings of the exhaust fan are on one side, leaving the inlet entirely unobstructed.

These exhausters are especially adapted for removing smoke and gas generated in blacksmith shops, chemical works and factories in general; for removing dust from emery and other polishing wheels, buffing machines; and for the removal of offensive odors from try kettles, varnish factories, etc.

For further particulars as to capacities, prices, etc., address the manufacturers, the Buffalo Forge Company, Buffalo, N. Y.

The Horton Chuck Co., of Windsor Locks, Conn., report business on the increase; they always keep a large collection of the different sizes of chucks on hand, so as to fill orders promptly. During the past six months they filled some of the largest orders they ever had.

Our attention has been directed to the Pope expanding lathe mandrel, which is a very useful device capable of greatly facilitating the finishing of cylindrical surfaces. One set of fine mandrels takes every $\frac{1}{100}$ part of an inch from 1 to 6¼ inches. It is reported to be the only mandrel that can be used without hammering. Manufactured by John G. Pope, Bloomington, Ill.

We have received from the Illinois Alloy Company, Chicago, a circular containing a great many testimonials as to the merits of the anti-friction metal bearings by parties using them. A fair specimen of the testimonials is given by Augustus Newell & Co., Chicago, and reads as follows: "We have used your anti-friction metal in places where no other babbitt would last any length of time, and find that your metal is more durable than anything ever before used in our factory. We can recommend same as the most satisfactory and economical babbitt in the market.

The Jos. Dixon Crucible Company, Jersey City, direct attention to the merits and growing popularity of their India silver lead for foundry facings. They say: Competition and a demand for fine work is everywhere driving foundrymen to procure smoother castings, and years of experience have demonstrated that of all the different facings made none approach India silver lead for the best results. If it costs a trifle more it is worth a great deal more, and is by far the cheaper in the end, as enough of the expense of dressing castings will be saved to more than pay for the facings.

We are in receipt of an illustrated catalogue showing the appliances manufactured by the Northampton Emery Wheel Company, Leeds, Mass. A great variety of emery wheel machinery is shown, and valuable information is given about the use and care of such machinery. Among the points given are:

But few men, even among skilled mechanics, realize to what extent implements made of emery and corundum can be used in doing the finest and most difficult work on metals. With suitable machinery, a large proportion of the work now done on planers and milling machines and with the file can be better and more cheaply done by the use of solid emery or corundum wheels than by any other known method.

An emery wheel is a revolving cutter that never gets dull, and that passes from 100 to 1000 times as much cutting surface over the article operated upon in a given time as any other metal working tool, and is the only implement, except the common grindstone, that cuts the hardest chilled iron and tempered steel with same facility that it cuts softer metals.

There is a growing conviction that the manufacturers of wood working machinery should convene in convention to regulate affairs and matters of interest to their trade. The buyers and users of this class of machinery will be benefited without a doubt, as the aim of the projectors of this interchange of ideas is to bring about a proper adjustment of conflicting opinions as to the best methods to serve their customers. Lumbermen and wood-workers are to be consulted to ascertain their desires so as to reach a better understanding of their wants, that improvements may be made and a uniform standard be adopted in quality, sizes and systems. The Egan Company, of Cincinnati, Ohio, have taken the initiative in this direction and are bringing about the necessary steps to have the builders of wood-working machinery come together at an early day. There is now no organized effort which has a tendency to give the wood-worker better and standard machinery for his purposes, and it is to his advantage that recognition be given to the promoters of this proposed betterment of the tools which are so essential in his business. At no time in the rise of this great industry have the manufacturers ever convened to become better acquainted with each other, and it is to be hoped that the outcome will bring around the best results to all concerned.

Our Directory.

We note the following changes since our last issue. Our readers will do us a great favor by giving us prompt notice of any changes that may come to their knowledge or of any error that may be noticed in our list:

Brooklyn, Bath & West End.—Mr. T. Dickinson has resigned his position as master mechanic.

Chesapeake & Ohio.—J. T. Harahan to be general manager, vice J. T. Odell, resigned.

Chicago, Kansas & Nebraska.—George F. Wilson has been appointed assistant general master mechanic and master car-builder of the road, with headquarters at Horton, Kan.

Central Iowa.—Mr. J. H. Redmon has been appointed superintendent.

Georgia Central.—Mr. Charles Blackwell engineer of machinery has resigned.

Florida Railway & Navigation Co.—D. E. Maxwell, formerly general superintendent has been appointed general manager, the former office having been abolished.

Minneapolis & St. Louis.—George F. Wilson having resigned the position of master mechanic to accept service with another company, W. H. Whittaker has been appointed acting master mechanic.

Mexican Central.—Mr. David Mackenzie has resigned the position of general superintendent.

Ohio & Mississippi.—Mr. J. A. Barnard has succeeded Mr. G. W. Stevens as purchasing agent.

Pittsburgh, Shenango & Lake Erie.—J. C. Grove has been appointed purchasing agent, with office at Greenville, Pa.

Suffolk & Carolina.—Charles H. Jones, Jr., has been appointed general manager of this company, with headquarters at Suffolk, Va.

West Virginia Central.—Mr. Emmons Blaine has become vice-president, with headquarters at Baltimore, Md.

Chicago, Santa Fe & California.—R. H. Emerson, master mechanic, Madison, Ia., has resigned.

NATIONAL CAR AND LOCOMOTIVE BUILDER

MAY, 1889.

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The Norfolk & Western Railroad Company will build large repair machine shops at Roanoke.

The Rogers Locomotive Works, of Paterson, N. J., have delivered a 30-ton 14 × 24 locomotive to the East Louisiana road.

The Union Pacific is said to be operating with about 3,000 fewer men on the pay rolls than it has been the custom to employ at this season of the year.

The Georgia Central is reputed to be suffering from Too Much Purchasing Agent, a malady that did much harm to the Baltimore & Ohio and other roads in the near past.

The Laconia Car Company, of Laconia, N. H., is busy with orders for 10 passengers for the Boston & Maine, 10 box cars for the Cheshire road, and 100 freight cars for the Upper Coos R. R.

The Pittsburgh Locomotive Works have commenced the erection of a new boiler shop 120 by 275 feet. They expect to make it one of the best equipped and most convenient boiler shops in the country.

A flash-light signal for the rear of trains is being tested in England. It shows a fixed light for a stationary train, and alternate flashes of red and white when the train is in motion, so arranged as to show whether the train is going forward or backward.

The leading Vanderbilt lines have given notice that they will not handle any freight on Sundays except stock and perishable goods. This is a practical movement to reduce as far as possible the running of trains on Sundays, so that employés may enjoy that as a day of rest.

The Erie Car Works, Limited, has been awarded a contract for building 500 gondola coal cars for the Valley road of Ohio. It is expected to complete 12 cars a day, when work on them is commenced. The orders which the works now have are sufficient to keep it busy for nearly a year.

Three passenger conductors on the Chicago, Burlington & Quincy road in Iowa were relieved April 8 for alleged dishonest practices. It is said that officials of the company have been suspicious of some of the conductors for several months and recently put detectives on the line, whose investigations resulted in the discharge of three men.

In the notes which we published last month, regarding mechanical matters on the Cincinnati, Hamilton & Dayton, when noticing the Butler spring protecter we made our correspondent say: "I do *not* think it is a device that ought to be better known." The word not was an unintentional addition, for the device is greatly liked and appreciated on the road.

The Inter-state Railroad Commissioners have interpreted the amendments to the Inter-state Commerce Act relating to notice of reduction of rates to mean that the three days' notice must count from the time that the Commission receives the announcement. This, in many cases, will be equivalent to prolonging the period of notice, but it is a move in the right direction.

The Canadian Pacific have lately built in their shops at Montreal some fast passenger ten-wheel locomotives designed by Mr. F. R. F. Brown, mechanical superintendent, that have some novel features. They have cylinders 20 × 22 inches, drivers 75 inches diameter, boiler pressure 180 pounds. The cab is of steel, with smooth finish to correspond with dome and sand box.

Several dastardly attempts have been ma de to wreck the New York & Chicago limited express, on the Pennsylvania Railroad, near Canton, O. The Chicago, Santa Fe & California have also been annoyed by the acts of attempted train wrecking in several parts of Illinois. Train wrecking is one of the most diabolical of crimes, and attempts at derailing trains ought to be given the highest penalty.

A Pennsylvania patentee has an electric brake that instantly brings to a dead stop a train running at the rate of 60 miles an hour. And now, who will invent another brake to stop the conductor, engineer and other trainmen, at the same instant the Pennsylvania man applies his brake. Otherwise the trainmen are likely to bring up a mile or two ahead of the train.—*Railway Service Gazette.*

Business on the Northern Pacific has been heavier the past winter and spring than it has ever been since the road opened, and the mild winter and floodless spring have enabled the operating department to do the work at unusually low expense. They are now badly in need of additions to their rolling stock to meet the growing demands of business. They are getting ten new first class sleeping cars built and twenty emigrant sleepers. This company manages the emigrant sleeper business in a way that might with advantage be imitated by the other railroad companies which are turning over this source of revenue to the tender mercies of the Pullman people. They put a man in charge of the emigrant cars and hold him responsible for the comfort and cleanliness of the passengers. By this means the travelers are kept as comfortable as if they were looked after by Pullman porters, and the railroad company gets all the profit that can be made out of the business. The company are having 60 refrigerator cars built at the Peninsular Car Works, Detroit, and they are talking of ordering 75 new locomotives or as many of that necessary number as they can venture on.

An experienced railroad timber dealer of this city says that you may talk about Oregon and Washington fir and southern pine for such a purpose, but white pine is better than either of them. He alleges against fir that it checks badly under the influence of the hot sun and blasting winds of the prairie regions, while white pine stands the climate first rate. Yellow pine, he says, rots quickly when exposed to the weather. He should qualify this by saying that the sap or white wood of yellow pine rots from exposure, but that the heart or red wood stands the weather well. Decay in yellow pine can be obviated, too, by painting. And what about cypress for railroad work? Its friends claim that it is very enduring when exposed to dampness—that it will last for generations without decay. But it is claimed that there is another side to the cypress question; that it disintegrates when exposed to the vicissitudes of the northern climate—scales up, splinters and falls into dissolution. In respect to coast fir, it is alleged that when it is placed in bridge work the vibration of passing trains shakes its grain apart, and thus impairs its strength. Thus the rival timbers have advocates and critics. Without doubt white pine timber is reliable for bridge work, and it will be used as long as it can be procured; but it is diminishing in average size and quality, and other woods will have to be substituted for it. It is a satisfaction to know that fir yellow pine and cypress will be sufficient to fill the bill fairly well when white pine has been played to the finish. —*Northwestern Lumberman.*

At the Auburn car shops the New York, Providence & Boston has under construction a passenger car from designs by the master mechanic, which will combine the features of the round roof and the monitor top. The car will be 53 feet 5¼ inches over all, and 9 feet 7½ inches wide; the monitor roof will be 13 feet 10 inches above rail level and the interior swell of the elliptical roof will be an antique oak panel and will be finished between the rafters and basket work in quartered oak. The car will have 17 windows on each side and two in each end, each 26 by 34 inches. Not a batten is used on the car, even the corner posts being grooved to receive the boarding.

The roof is, perhaps, the most remarkable feature of the car. The car lines are of iron, 2 by ½ inches, and in form are exactly half of an ellipse. There are 18 of them, and each has a crow-foot turned out on either end, which is secured through the plates by two bolts. When the car is finished the car line will be concealed by an ornamental wooden covering. At the highest point of the ellipse the slightly bowed rafters of the wide monitor roof are attached, the difference in their curvature affording space for the ventilating windows. The car will be heated by steam and lighted by gas. Near the steps on each side and at each end of the car are openings about 2 by 6 inches, arranged to draw in fresh air and exclude the dust, and these connect with a duct extending about 10 feet down the car near the floor, from which, through a small slit, fresh air will be forced into the car when it is in motion. The car will be carried on two four-wheeled trucks with 38-inch steel wheels.

The construction of the shops at Cheyenne has commenced, and of the buildings to be erected, many of them will be ready for occupancy by Nov. 1. The following is a list of the shops that will be built during 1889: A machine and erecting shop 125 × 225 feet will be built, and the plans show that future extensions as large again will be made. Adjoining are a lavatory 25 × 50 feet, a stack house 12½ × 12½, and an engine and boiler room 12½ × 60 feet. A blacksmith shop, 263 × 80, will be put up immediately, the plans showing that an extension 90 × 80 will be added next year. A transfer table 70 × 285 will be made to answer for the coming year. A freight repair shed, 70 × 200, with an extension 70 × 100, is to be erected and tracks will be laid to make a repair yard immediately adjoining with a capacity of 150 cars. This freight car repair yard was not contemplated at first. A boiler shop 100 × 150 feet, with an addition 50 × 48 feet, and a future extension is to be added, 80 × 150 feet. A copper and tin shop 50 × 175 is to be built around one of the present buildings. The present round house with 20 stalls will not be demolished, but the circle is to be completed so as to accommodate forty locomotives. The coal pockets are to be made 240 feet long, an addition 100 feet long for sand added and an additional ash pit put in between the present coal chutes and the water tank. On either side of the viaduct crossing Central avenue track room for 1,000 cars is to be made, so that 500 freight cars can stand on the east side and an additional 500 cars on the west side of the long bridge. The greater portion of the tools for these shops will be furnished by Manning, Maxwell & Moore, New York, and the Niles Tool Works Hamilton, O.

A Long Run.

On April 8 engine No. 247, of the ordinary eight-wheel type, Phil O'Neil engineer and E. S. Williams fireman, drawing the special train of Dr. Webb, of the Wagner Palace Car Company, made the continuous run from Chicago to the transfer at Council Bluffs, a distance of 490 miles. The train consisted of four Wagner cars, and the run was made in 12½ hours, including 18 stops. Deducting 50 minutes (estimated) for these stops, the average speed for the entire trip was about 41¼ miles per hour. The speed recorder showed a speed of 64½ miles per hour between Colorado and Nevada, a distance of seven miles, while the 4.1 miles from Norway to Watkins was made in 3½ minutes. Although this time is 3½ hours less than the schedule time of the Northwestern's limited train between the two cities, General Superintendent Sanborn feels very sure that it could easily have been shortened one hour, had speed been the object of the trip. The engine was in prime condition on reaching Council Bluffs, and the engineer telegraphed to headquarters that he was ready to start back to Chicago at once. He did make the return trip the next day with a regular train. Engine No. 274 was built at the West Chicago shops of the Chicago & Northwestern road in 1884 under the supervision of G. W. Tilton, Superintendent of Motive Power. It has 18 × 24-inch cylinders, 63-inch drivers, 52-inch boiler with 201 flues and 1,228 square feet of heating surface. It weighs 90,900 pounds, with 57,800 pounds on drivers, and the total weight of engine and tender is 151,100.—*Railway Age.*

Tractive Efficiency of Electric Locomotives.

Reference has been made to the fact that the electric locomotive will draw a considerably heavier load than the steam locomotive of the same weight, and the suggestion advanced, that it is due to some electric condition of the rails and wheels. While I believe it has been clearly shown that certain things slide one upon the other much more freely when a current of electricity is passing from one to the other than when not, I do not know whether, in the case of the Ninth avenue cars, the electricity passes from the wheels to the track, but if it does the result is quite the reverse from the action assumed in the case of the locomotive wheels, and it does not seem at all necessary to refer the matter to any electrical or magnetic theory, as the mechanical conditions alone are such as to explain the apparent inconsistency, and in this way: The power of the electric motor is constant and the steam intermittent. If the steam locomotive has but a single cylinder, and the power required to draw the train be 700 pounds, the force exerted by the piston would be 0 when the crank was at the dead center, and 1,100 pounds at the maximum; so that, while the electric motor doing the same work would exert only 700 pounds towards slipping the wheels the steam locomotive with one cylinder would at times exert a force of 1,100 pounds. This assumption does not take into account the varying steam pressure nor the angularity of the connecting-rod, which in certain positions would make it more, nor the weight of the reciprocating parts and inertia of the drivers, which would make it less, though, as slipping takes place in starting the train, the inertia would have but little influence.

It is true that steam locomotives are not single cylindered, and at first sight it would seem that that makes a vast difference, and that with two cylinders the impulse is almost constant; but even assuming the steam pressure to be constant throughout the stroke, as was assumed with the single cylinder, the rotary effect of the two cylinders is not constant, and (unless I am badly mixed in my diagram) with a mean 1,400 pounds, or double the mean of the single cylinder, there will be a minimum of 1,100 pounds, and a maximum of 1,571 pounds. This variation, together with the varying steam pressure on the piston, it would seem, is sufficient to account for the extra efficiency of the electric motor, if I am correct in my assumption that the limit in both cases is the slipping of the drivers.—*John E. Sweet in American Machinist.*

SHOP AND ENGINEERING NOTES.

Editorial Correspondence.

IN CINCINNATI.

Early in March I left New York for a tour that would extend as far westward as time and the attractions met by the wayside would admit of. The first point that claimed a stop over was the fair city of Cincinnati. There are cities on this continent that have the right to be considered ahead of Cincinnati as railroad centers, but I do not think there is any city in America where the inhabitants take a more absorbing interest in railroad matters. Both the leading daily papers run excellent departments of railroad news, which is no doubt done to meet the demand of the readers, and Mr. Shields, of the *Inquirer*, and Mr. O'Shannessey, of the *Gazette*, hold a close rivalry in making the best column of railroad news in the country.

While I was in Cincinnati, the principal topic of conversation was the absorbing of the Big Fours by the Bee Line. In some quarters strong dissatisfaction was expressed at the spirit of existing Ohio laws that tend to force the ownership of railroad property out of the State. But in the consolidation of the two properties named there was general satisfaction on account of the president being located in Cincinnati. Mr. Ingalls is highly popular with businessmen, and I heard him warmly praised on all sides.

LITTLE MIAMI SHOPS.

My first visit was to the Little Miami shops, presided over by Mr. Leroy Kells. The shops are a variety of buildings strung along the side of the main track on the breast of a high hill, a very inconvenient arrangement to my mind. Since the Little Miami became part of the Pennsylvania system the work of these shops has been confined to repairs ; but they appear to do a good deal of that with limited facilities. Working about one hundred men they take care of 60 locomotives and 100 passenger cars. The service is no trifling kind either. They are running some of the engines 7,500 miles a month regularly on passenger trains. They use the Ross brake shoe with these engines, and the tires run about 100,000 miles between turnings. All the engines have brick arches, and most of them have air openings at the sides of the fireboxes. The train service is remarkably clean for soft coal burning locomotives, and the principal credit of that is, no doubt, due to the combination of brick arch and air openings above the fire. Another notable thing about the engines is the absence of overheated signs around the cinder hoppers of the extension smoke-boxes. Nearly everybody says "we have no trouble with extension fronts getting hot;" but all the same, I seldom go about a round-house without seeing traces of the hopper casting of some of the engines having been hot.

There are a good many ingenious make-shifts followed in the machine shop to get work done without suitable tools. A somewhat unusual plan is to face steam chest glands and other articles too large to swing in the lathes they have by putting the slide rest in the face plate and securing the work stationary. The feed is operated by a stud, which catches the handle at every turn of the lathe spindle.

They have in use on some of the engines of this road a link hanger with a bearing about 6 inches long. Mr. Kells speaks very highly of its durability, and of its good effect upon the other working parts connected with the link. It seems to me worthy of being brought into general use. All the engines have a rod to catch the eccentric rod in case of breakage. United States gland packing is used in all the engines, and it is very much liked by the men. In the blacksmith shop they have a boiler which has been in 19 years, and the flues, which are copper, have never been changed.

CINCINNATI, NEW ORLEANS & TEXAS PACIFIC SHOPS.

The Cincinnati, New Orleans & Texas Pacific had the nominal misfortune to get their principal shops at Ludlow, Ky., burned down. As in the case of most old shops, the fire was a blessing in disguise, and the company are now beginning to reap the benefit of getting the work done in modern shops, planned to perform operations systematically, and filled with tools properly adapted for doing the work to the best advantage.

The new shops, which were designed by Mr. James Meehan, superintendent of machinery of the road, and built under his supervision, are made amply large for meeting the increase of business that may be expected for the next ten years, and the general plan is such that large extensions can be made conveniently. The main building is 100 by 440 feet, the machine shop taking up 218 feet of that, the boiler shop and the blacksmith shop taking up the remainder. Forming a wing to the main building is a structure which is divided into engine-room, and under another roof are the tin shop and brass foundry. The buildings are of brick, with stone trimmings and slate roof. Great care has been taken to admit daylight freely into the buildings, and they are lighted at night by electricity. Heating is done by steam, the radiators being set round the supporting pillars in the shops. A fine Lane & Bodley Corliss engine drives the machinery, and steam is supplied by a battery of tubular return flue boiler. The shops cover 2½ acres.

When the arrangement of the shops was under consideration, Mr. Meehan weighed very carefully all the testimony in favor of having large traveling cranes to traverse the shop; and he finally decided not to use large cranes. He believes that it does not pay to put cranes capable of lifting locomotives into a locomotive repair shop. The plan he has adopted is to raise by power on the transfer table every engine coming into the machine shop, take the wheels from under her there, put the machinery into a vat, at hand, to be cleaned, and from that point send all parts to the place where work has to be done--the engine on trucks to the repairing stall, the driving wheels to the wheel lathe, the rods to the rod bench, and so on. The plan looks practicable, and if properly carried out may be the means of preventing the frequent handling of the parts. The shop is laid out with the tools on one side, and the erecting pits at the other, and set at right angles to the length of the building in the usual way. Part of the main shop is walled off as a shop for grinding apparatus. Opposite to it, and at the end of the tool floor is the tool room, fenced in and very finely equipped with the most approved forms of small tools, gauges and measuring devices. Annunciators put this room in connection with all parts of the shops, and when any workman wants a tool he rings an electric bell, and a boy finds what is wanted and carries it to the workman.

Along the whole length of the main shop there is a line of light shafting for operating by rope connection cylinder boring mills, valve seat facing machines, flexible drills, and all tools that can be operated on the engines in the stalls. Every tool in the shop that takes in pieces beavier than one man can lift conveniently, is provided with a hoisting apparatus operated by compressed air, pipes carrying this medium of power throughout the whole establishment. This compressed air is also used for many other purposes.

The blacksmith shop is exceptionally well arranged; but it is short of machinery that it ought to contain. I noticed them making bolts by hand, a rather expensive practice, and then I saw that they had no bolt header. The foreman, Mr. Jeffery, is, however, a master of his business and has devised numerous formers and labor-saving devices. They have a peculiar way of balancing frames that are being handled. It is well known that a frame is awkward to handle in moving it between forge and anvil, the center of gravity being so far from the main bar that the frame cannot be held level by one man. In this shop they fasten a heavy cast-iron clamp to the main frame in such a way that it counterbalances the pedestals and brace bars, with the result that a blacksmith holding the main bar can keep the frame level or put it into any position necessary in forging. The clamp can be moved out and in, so that greater or less counterbalance can be given as the work proceeds. The forges are the best I have ever seen. They are patterned after forges I saw in the blacksmith shop of the Caledonian Railway shops at St. Rollox, Glasgow; but various improvements have been made on the original. They are made of cast iron with a hood of the same material. There is a coal pit under each forge and a cinder pit behind, and there are various convenient contrivances about them that will be appreciated by every blacksmith. I should advise any master mechanic who is building a new blacksmith shop or improving an old one to get drawings of these forges from Mr. Meehan.

The rest of the shops were not in perfect running order, and a visitor could only judge that they would all, when finished, constitute a very convenient and orderly establishment. Mr. Meehan is helped by a highly intelligent and efficient staff of foremen. Mr. J. J. Sullivan, the general foreman, is a young, progressive man, well versed in all the advanced methods of doing work, and the others share his spirit.

The fire did not extend to the quarters occupied by Mr. John Richardson, the master car-builder, and his work is still done under the inconveniences of want of room in antiquated shops. The expectation is that new car-shops will be built in the near future. The offices for the shops and several other buildings have yet to be erected to complete the plan as laid out.

NILES TOOL WORKS.

An hour's ride through a beautiful and interesting country brought me to Hamilton, O., familiar to railroad mechanical men as the location of the Niles Tool Works. Years ago I received a very impressive lesson on describing machinery from Mr. Alex. Gordon, general manager of these works, and I was very glad to avail myself of this my first opportunity of visiting the shops where he is the presiding genius. The works are very large and finely arranged for convenience in operating. Land is not held at such fabulous prices here as it generally is in manufacturing cities, and these works have not been contracted through want of room. They cover about eight acres of ground, and every building is arranged with a view to its greatest convenience as a part of the whole plan. The buildings form a slightly irregular square, the main machine shop, which is 394 by 116 feet, forming the principal side. This main machine shop is of the greatest interest to railroad men, and I shall confine myself principally to what I saw there. Two rows of pillars are set along the shop and give support to galleries where light tools are placed, besides partly supporting the roof, and sustaining without stress to the building the pressure of a heavy traveling crane which traverses the shop from end to end and is kept very busy at work all the time. The pillars also hold up the line shafting, and trussed jib cranes are secured to different pillars. All the heavy tools, and some of them are extremely large, are placed in the middle floor, so that the work can be handled by the traveling crane. Most of our readers are familiar with the boring mills made by these works; but few have seen anything but the pigmies of this class of tools turned out. There were six boring mills on the floor intended for the government arsenal at San Francisco that weigh over 130,000 pounds each. They take in a piece 20 feet diameter. There were 21 more boring mills on the floor in different stages towards finish which varied in capacity from 6 to 20 feet. Another tool that few shops could find room for was a 34 feet planer, 8 feet square and wegihing 44 tons on the ways.

Hard times have not struck the Niles Tool Works at this period, for they are working 23 hours a day with all the men that can be conveniently employed. They are getting a fair share of railroad business, and I am persuaded that they would get more if the men who order tools could be round the shops to watch the careful and painstaking work that the very skillful workmen put upon the tools turned out. There are few heavy tools used in railroad shops that could not be seen in course of construction here. The well-known radial drill, the driving wheel lathe, the boring mill and car wheel lathe and the various other lathes built by the Niles Tool Works, and which do not require to be described to railroad mechanics, could be seen in all degrees of finish, and the work and material are alike creditable to the makers.

In the course of a lingering ramble through these shops a railroad mechanic meets with a good many surprises and is apt to find food for profitable cogitation. A mechanic accustomed to engine work naturally associates the finish on large pieces with a certain roughness or want of accurate manipulation. But here he finds parts more ponderous than the average large engine work that have to be finished with an exactitude and precision resembling mathematical instrument making. An ordinary machinist is of no use on finishing work in this establishment till he has acquired the special skill called for in tool making; and few machinists accustomed to doing the most difficult work met with in the tool room of a railroad shop could handle, without special training, the run of work that has to be done here. Scraping and tapping appear to be worked down to the closest refinement of the art.

A striking feature about this big establishment is the quiet, orderly way in which all the work and operations proceed. If I remember rightly this is Sackett's shop as described by Mr. James See in "Chordal's letters." It appears well worthy of the mechanical celebrity Lee gave it. A disappointment connected with my visit to Hamilton was that I failed to find Mr. James See at home, the man who wrote a book on machine shop lore and made it as interesting as a well-written romance. A. S.

The Cause of Uneven Chilling.

Whatever may be said about the contracting chill, and whether it really possesses all of the advantages that its advocates claim for it or not, it has demonstrated the fact that it is the only way to procure evenness of chill around the whole tread of a wheel.

Until very recently the makers of cast-iron car wheels have been puzzled by the fact that the chilling was invariably deeper on one side of the wheel than on the other, and though recognizing the fact have regarded the reason therefor as impossible of solution. Some experiments a short time ago made the whole thing as clear as daylight. A flat chilling surface was made, and so placed in the flask that it could be readily removed after the iron had been poured. Repeated tests showed that by removing the chill, as soon as the iron had solidified enough to stand, lessened the depth of the chilled iron; and that this depth was dependent upon the length of time in which the chill was allowed to remain in contact with the cooling mass.

Now how does this affect the casting of the ordinary car wheel ? The cope, chill and drag are usually, if not invariably, held together by clamps that are tightened by driving wedges between the upper hooks and the edges of the cope. The surfaces of contact between the cope and chill, and chill and drag, are such that under the conditions in which the clamping is done, it is impossible to bring an even pressure over the whole of these surfaces. Therefore, as soon as the iron is poured, the old style of chill begins to expand from the heat communicated to it. As it is invariably held to the cope more tightly on one side than on the other, that side remains rigidly in contact with the metal, while the effect of the whole of the chill's expansion is made manifest on the other or looser side by the instant separation of the expanding chill from the hot and recently solidified metal of the wheel. This explains why it is impossible to procure a perfectly even chilling of the tread of a cast-iron wheel with the rigid chill, and why such results are obtained by the use of a contracting chill that hugs the hot metal of the wheel up to the time of its removal from the sand to the annealing pits.

Compound Locomotives.

At the April meeting of the New England Railroad Club, President Richards in the chair, the following paper was read by Mr. Angus Sinclair, Editor NATIONAL CAR AND LOCOMOTIVE BUILDER, New York:

The interest of American mechanical engineers in compound locomotives has lately been stimulated through the importation by the Pennsylvania Railroad Company of a compound locomotive built according to the design of Mr. F. W. Webb, the famous locomotive superintendent of the London & Northwestern Railway, one of the pioneers in this line of engineering progress. The existing awakened interest in the subject is my excuse for offering the compound locomotive as a theme for discussion.

Compound locomotives have been working successfully on European railways for upwards of twelve years, yet practically nothing has been done on this continent to demonstrate the value of this system of steam using, an apathetic condition that may be attributed partly to two causes: 1st, the antipathy which American locomotive designers have always displayed to any change of form likely to increase complication of parts; 2d, to the fact that no heavy pressure has ever been put upon our railroad mechanical officers to effect rigid economy in the use of fuel. Although the desirability of using fuel economically has been discussed a great deal among us of late years, on many roads enginemen still act as if the coal placed on tenders was as cheap as the water passed into the tanks. While these ideas prevail sufficiently to influence opinion, little practical interest will be displayed in compound locomotives, or in any other improvement of railway motive power, offered for the purpose of preventing waste of heat.

As most of you are aware, a compound engine passes the steam through two or more cylinders for the purpose of utilizing to the fullest extent the expansive force of the steam. The economical advantage to be derived from making steam perform work through its expansive force, has been recognized ever since the steam engine was successfully applied to manufacturing purposes; and it was the desire to convert the expanding faculty of steam into mechanical energy that first led to the proposal to expend the steam in more than one cylinder. More than a century ago Jonathan Hornblower patented a compound engine in England, and he was succeeded at various times by others who attempted to improve on the arrangement of his invention. During the first half of this century, many compound engines were built and they became noted for their durability, which was due to the strains being more evenly distributed than in simple engines; but owing to the low pressures of steam in vogue there was no marked economy in the use of fuel. In fact, the operating of the early compound engines had led many physicists and engineers to conclude that no economy could result from the expansion of steam in more than one cylinder. As early as 1825, James P. Allaire, of New York, built compound engines for marine service that used the steam more economically than any engines that ever had been worked up to that time; but American engineers were prejudiced in favor of the light, high-pressure, high-speed engines that had become the national type, and Allaire's ingenuity, skill and enterprise did nothing to convince the engineering world that the compound had the inherent right to become the engine of the future.

Not till 1854 did the forerunner of the most advanced and economical steam engine yet invented appear, the designer being John Elder, a member of a well-known ship-building firm of Glasgow, Scotland. Elder was an accomplished mechanical engineer and an industrious investigator into the peculiarities of heat phenomena. He perceived that the compound engine had proved more efficient than the single cylinder engine, only when the pressure of steam carried, and the extent to which expansion was carried, exceeded the practice customary at that time. Following the obvious teaching of this fact he applied high steam pressure and a high ratio of expansion to well-designed compound engines of the modern vertical inverted type, and at once reduced the coal consumption from 5 pounds to 3¼ pounds per horse-power per hour. As boiler pressures were still further increased and greater improvements effected on the mechanism the coal consumption was reduced below 2 pounds per horse-power per hour.

This was the greatest improvement that had been effected on the steam engine since the separate vessel as a steam condenser was applied, and the economy of fuel that resulted has made the high speed now common in marine service possible. The change to compounding was not, however, consummated without strenuous opposition, many engineers of high repute fighting step by step in favor of the simple engine.

When compounding of marine engines became a generally recognized success the principle soon made progress into stationary engine practice. Locomotive designers next took up the idea of expanding the steam in more than one cylinder, and within the last ten years about 600 compound locomotives have been built and are now at work.

If the opposition to compounding marine engines was stormy, the antagonism to applying the principle to locomotives has been cyclonic. If the compound locomotive ever becomes the railway motive power of the future, it certainly will not attain popularity through apathy on the part of the opponents of change.

The fundamental purpose of all intelligent improvers of the steam engine is, to convert an increased proportion of the heat energy in the steam that passes from the boiler into the mechanical energy that drives machinery and performs other kinds of work. An axiomatic principle recognized by all engineers versed in thermo-dynamics is, "The higher the temperature of the steam when it enters the steam cylinder, and the lower that which it reaches before the exhaust occurs, the greater will be the efficiency of the engine, if the reduction of temperature has been caused by the conversion of heat into useful work." The engine that will best perform this function of transforming the energy of heat into work will in the end prove the most efficient machine.

Locomotive improvers have clung very ardently to a certain sound principle in steam engineering, and generation after generation since the time of Stephenson have moved in cycles, working on the problem of getting the steam quickly into the cylinders at near boiler, cutting it off at the shortest possible point consistent with the work to be done, and expanding it as low as practicable before opening the exhaust. Mr. D. Kinnear Clark, the eminent engineer, who wrestled long with difficult investigations into the most economical methods of operating locomotives, came to the conclusion nearly half a century ago that expansive working was expensive working; yet his discoveries did not deter others from laboring to perfect means for admitting and cutting off steam quickly, with a view of obtaining a high ratio of expansion in locomotive cylinders, but the labors in this direction have uniformly resulted in disappointment. Clark, who first demonstrated that a high ratio of expansion in a locomotive cylinder was not conducive to economy, discovered and explained the cause, and at the same time furnished a rational solution of the difficult question why a compound engine providing for a higher ratio of expansion than a simple engine might yet be more economical.

This discovery was to the effect that the cylinder of a steam engine acted alternately as a condenser and as a boiler, condensing a portion of the steam during admission and revaporizing the resulting water of condensation during the period of expansion and exhaust. This is due to the interaction of the metal of which cylinders are made, and would not happen if a non-conducting material were employed, but as all metals suitable for the construction of cylinders are good conductors of heat, the alternate condensing and revaporizing of the steam is inevitable, and its evil effects are magnified in proportion to the difference in the variations of temperature.

Owing to the defects of the valve motion used on locomotives and other causes, steam is seldom cut off earlier than quarter stroke, which permits an approximation to four volumes of expansion. This is not pronounced enough to develop the evils of cylinder condensation in an aggravated form. But suppose by the use of an improved motion it is made practicable to admit steam for only 4 inches of a 24-inch stroke. The expansion then will be six volumes, and it will be found beyond the line of economical expansion in simple locomotives. Suppose the steam is admitted at 160 pounds absolute pressure, or a little over 145 pounds gauge pressure, and expanded to six times the original volume. The exhaust pressure will be about 26 pounds. The temperature of the steam on admission would be 363 degrees Fah. and at release it would be 242 degrees, making a variation in the temperature of over 120 degrees. The metal of the cylinder tends to adjust itself to the temperature of the steam giving or taking heat during the recurring events of the strokes. The cool exhaust steam has imparted its temperature to the cylinder, and when the hot steam from the boiler passes through the ports at the beginning of next stroke, it goes into a comparatively cool cylinder, the metal of which absorbs heat till it is raised to the temperature of the steam. Saturated steam is constantly on the dew point, and on the least portion of the heat of vaporization being abstracted, a corresponding quantity of the steam falls into water just as it does inside of a condenser. When the steam becomes water in the cylinder, it loses its power to do mechanical work, therefore the percentage of steam that condenses through the interaction of the cylinder metal represents so much loss of power. A portion of the steam condensed becomes spray, and helps to dampen the steam filling the cylinder. When the steam is cut off and expansion proceeds, part of the heat is converted into mechanical work, and a proportional amount of condensation takes place. By the time the release point is reached the pressure of steam has become low and the relief of tension inclines the water to flash back into steam, and it draws on the metal of the cylinder for heat which acts as fuel to turn the condensed water into steam. This happens during the period of release and return, when that end of the cylinder is open to the atmosphere, so the re-vaporization of the water represents unmitigated loss of heat.

This may appear a fine spun theory to those who have not studied steam matters closely; but it is a theory based on the discoveries of highly practical men. The serious losses that occur in the steam engine through cylinder condensation and re-vaporization are well-known, and have been as clearly proven as anything belonging to steam engineering, yet few railroad men act as if they properly realized the importance of the matter. There are probably few locomotives that lose less than 20 per cent. of the steam used through cylinder condensation. Locomotive cylinders are more exposed to refrigerating influences than the cylinders of any other form of engine; yet very little attention is bestowed upon furnishing them with the best protection that care and ingenuity might devise.

In the compound engine the losses due to excessive cylinder condensation are prevented by avoiding extremes of temperature, and by utilizing part of the revaporized steam. The steam of 160 pounds absolute pressure and 363 degrees temperature would be cut off in the high pressure cylinder at about ⅛ stroke to obtain six volumes of expansion and passed into a receiver at a pressure of 53 pounds and temperature of 285 degrees. The difference in temperature between the initial and the terminal pressures in the low pressure cylinder would be even less pronounced. Any re-vaporization of water that follows condensation in the high pressure cylinder does not cause much loss in a compound engine, for the regenerated steam passes into the receiver and is utilized to perform work in the low pressure cylinder instead of escaping uselessly into the atmosphere as it does from the cylinder of a simple engine. These are the causes that make expansion of steam in the successive cylinders of a compound engine more economical than the same ratio of expansion carried out in a single cylinder.

The business of operating European railways is done on a very close margin of profit, and the officers in charge of machinery are constantly under urgent pressure to effect saving wherever it is possible. Economy of fuel has always received strict attention, and the saving effected by compound engines in marine service made locomotive designers anxious to obtain a share of the saving for railway motive power. An attempt was made in England to introduce the compound principle in locomotive practice even before it was made a decided success with marine engines. As early as 1850 Mr. John Nicholson, an engine driver on the Great Eastern Railway, designed a compound locomotive, and several were built and used for a few years. He had a high pressure cylinder on one side and a low pressure cylinder on the other, live steam being used in both cylinders for starting. The cylinder ratio was 1:2. The proportions were as good as anything produced by later designers, and I see no reason why Nicholson's engines were not made a permanent success, except that no influential railroad officer was interested in floating the system over the shoals encountered by all improvements in railway motive power when they are first introduced.

To a French engineer belongs the credit of originating the movement that has made the application of compounding to locomotives a success. Mr. Anatole Mallet became convinced that the locomotive could be materially improved by compounding, and he advocated the change so convincingly that in 1876 the Bayonne & Biarritz Railway Company had two compound locomotives built according to the designs of Mr. Mallet. The engines were in a great measure experimental, but they proved a decided success, and the general design was as good as anything subsequently brought out, but experience has modified some of the proportions adopted. The engines had outside cylinders, that for high pressure steam being 9½ inches diameter and the low pressure cylinder 15¾ inches diameter, the ratio of size being 1 : 2.78. The stroke of both pistons was the same, viz., 17¾ inches, and the cranks were set at right angles, as in common locomotives. Provision was made for passing steam direct from the boiler to both cylinders in starting or on heavy grades, but the ordinary method of working was to admit steam from the boiler into the high pressure cylinder only. After following the piston in this cylinder as far as the train pulled rendered necessary, the steam was cut off and expanded to the finish of the stroke, when it was exhausted into a receiver of about the same capacity as the high pressure cylinder, from whence it passed into the low pressure cylinder, admission being regulated by an ordinary slide valve. The steam receiver and the method of admitting steam to the cylinders were the principal improvements which Mr. Mallet made over the compound locomotive designed by Mr. Nicholson.

The Mallet system with a few modifications was adopted by Mr. Von Borries, mechanical superintendent of the Hanover Railroad; by Mr. T. W. Worsdell, locomotive superintendent of the Great Eastern Railway of England, and many other mechanical heads of railroad companies, so that under different names there are more compounds of the Mallet design at work than all other types of compound locomotives combined. The leading features of the engine are a single high pressure and single low pressure cylinder connected to cranks set at right angles, the ratio of cylinders being about 1 to 2. Slide valves are used which cut off steam in either cylinder at the points found most desirable for economical working. A receiver intervenes of about the capacity of the high pressure cylinder between the high and low pressure cylinders. The engine is very little more complex than a simple locomotive.

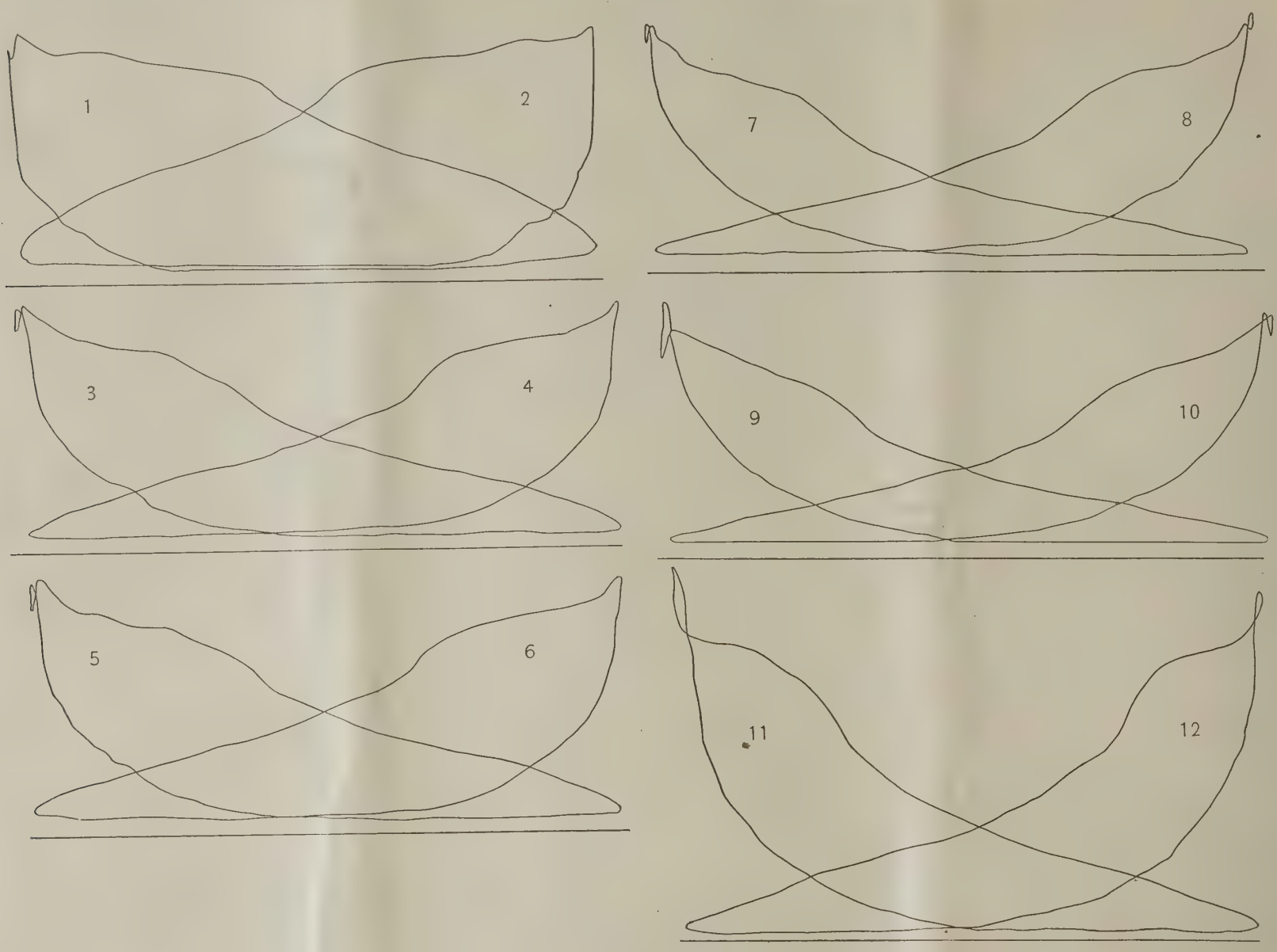
Two years after the first compound locomotives built according to the Mallet plans were put into service, Mr. F. W. Webb, locomotive superintendent of the London & Northwestern Railway converted an old locomotive into a compound on the same general design. This engine was kept at work regularly for three years and a close record of her performance convinced Mr. Webb that the compound principle was worthy of a more extended trial. There is a great antipathy among English engineers to the use of side rods in high speed locomotives, and Mr. Webb conceived the idea of utilizing the compound principle in such a way, that the necessity for coupling rods would be obviated. This conception was reduced to practice by the designing of a three cylinder compound locomotive consisting of two high pressure cylinders placed outside the frames and connecting with the back pair of driving wheels, and a single low pressure cylinder placed under the smoke-box and transmitting power to the front pair of driving wheels through the medium of a cranked axle. After considerable changes were effected suggested by experience with successive engines of this general design, the inventor has settled upon the style of engine lately purchased by the Pennsylvania Railroad Company, and spoken of by the designer as being of the "Dreadnought" class. This locomotive has three cylinders of 24-inch stroke. The high-pressure cylinders are each 14 inches diameter and the low-pressure cylinder is 30 inches diameter. The ratio of high-pressure cylinder to low-pressure cylinder is 1 to 2.3. This is a larger proportion of low-pressure cylinder than most other designers of compound locomotives have adopted, but it has been settled on by Mr. Webb after considerable experience with different ratios. According to marine engine practice, the measure of a compound engine's capacity is the size of the low pressure cylinder. This applies to compound locomotives only after the engines have got into running speed. When working in this way the Pennsylvania compound locomotive has a cylinder capacity equivalent to that of a simple engine with cylinders 21.21 × 24 inches. For starting a train from rest, however, the engine has a power equal only to the capacity of the two 14 × 24 high pressure cylinders.

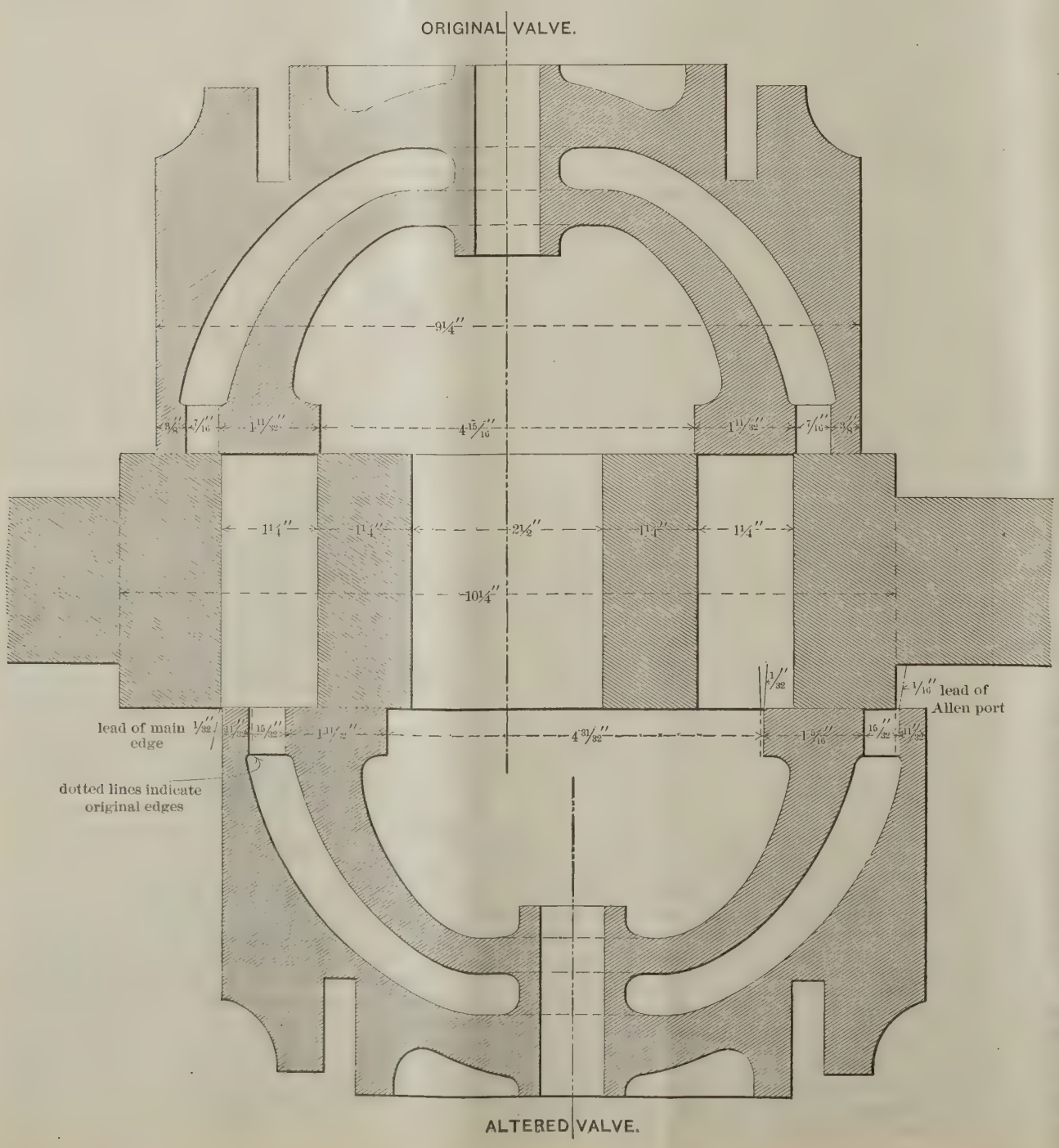
Steam passes from the boiler to the steam chests of the high pressure cylinders, which are placed beneath the cylinders, and admission is regulated by Allen valves working below the valve seat. An advantage of this arrangement is, that the valves fall away from the seat when the engine is running without steam and the pumping action of the pistons is prevented. After doing its work in the high pressure cylinder the steam is exhausted into a receiver of about the same cubic content as the high pressure cylinders, formed of pipes placed in the smoke-box where the steam gets slightly re-heated. From this receiver the steam passes into the low pressure steam chest located above the cylinder, and its admission into the cylinder is regulated by a common D-slide valve. After doing its work in the low pressure cylinder, the steam escapes into the exhaust pipe and thence by way of the smoke-stack into the atmosphere. The valves are operated by Joy's valve motion.

The Webb system of compounding locomotives is better known to American railroad men than any of the other systems, through having been illustrated, described and discussed very freely in railroad and engineering journals; but the Mallet system has been applied to the greater number locomotives. The improvements applied to the Mallet compound by Messrs. Worsdell, Von Borries, and others, have made it about as easy to operate as a simple locomotive. As has already been mentioned, this form of compound locomotive has two cylinders set in the positions usually occupied by the cylinders of simple engines, the high pressure cylinder being on one side, and that for low pressure on the other. Most of these engines are now provided with an auto-

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MAKING THE ALLEN VALVE REDUCE COMPRESSION.





On the Cincinnati, New Orleans & Texas Pacific heavy passenger trains that stop frequently have to maintain a high average rate of speed, and the problem is constantly before the mechanical department of how to make the locomotives running these trains do the work promptly and at the least possible expense. Experience with a great many different arrangements of valves has convinced Mr. James Meehan, superintendent of motive power, that by the use of the Allen valve steam can be saved, and that the engines do the combination of fast running and heavy working considerably better than when equipped with the plain valve. For these reasons he is using the Allen valve on nearly all his passenger engines. Although it is superior to the common D slide, the Allen valve is not found to be perfectly satisfactory, and Mr. Meehan has been experimenting lately to try and improve its working. The annexed engraving shows the "original valve" used on the road, and beneath the seat the dimensions of an "altered valve." The original valve has $\frac{7}{8}$ inch outside lap and $\frac{1}{8\,8}$ inch inside. The supplementary port is $\frac{7}{16}$ wide, and is so designed that it begins to open for the admission of steam at the same time that the outside edge of the valve begins to uncover the steam port. This is the ordinary arrangement, and it secures a well sustained pressure after admission on short points of cut-off; but it was found that the compression was so great when the reverse lever was drawn close up that the engine did not run freely, and developed the holding back action so well known as being due to excessive compression. This was not, of course, increased by the Allen valve, for it would havebeen the same had a plain valve of the same dimensions been used. The employment of the Allen valve, however, suggested what might be a remedy, for Mr. Meehan conceived the idea of making the supplementary port act to relieve the cylinder of a portion of the excessive pressure developed before the valve opens. So he cut away the supplementary port, as shown in the "altered valve," making it $\frac{1\,5}{8\,8}$ inch wide. This, as will be seen by an examination of the engraving, gives the supplementary port $\frac{1}{16}$ inch lead ahead of the outside edge of the valve. The idea was that when the vapor of compression went above the pressure of the steam chest, which it would do about the instant the supplementary port began to open, it would pass into the steam chest and equalize the pressure. It is, in fact, an ingenious method of increasing and accelerating

he lead without advancing the period when compression begins.

The first change of this kind had been made the day that the writer happened to be visiting the Ludlow shops, and Mr. Meehan invited us to apply the indicator to the engine for the purpose of finding out how the change worked. We accordingly went out the next morning with a train the engine was entered for and took a number of diagrams, part of which are shown on the opposite page. The cords up to and including No. 10 were taken from the engine with the supplementary part cut out, and Nos. 11 and 12 were taken with the "original valve." The diagram with the latter numbers was taken with a 60-pound spring in the indicater and the others were taken with the same instrument when an 80 pound spring was in. An improved Tabor indicator was used.

It will be seen that the change in the valve prevented the pressure from ascending far above initial pressure. The difference was very marked when a large number of the cards were compared.

With a total load of about 270 tons the engine got the train quickly into speed, ran up a long ascending grade without losing speed and making diagrams like 3, 4, 5 and 6. On a level stretch the diagrams 7 and 8 were taken, which was at a speed of nearly 55 miles an hour, the piston speed being 1,104 feet per minute. On a slightly descending grade that succeeded a speed of 64 miles an hour was attained, the piston speed being 1,288 feet per minute. Diagrams 9 and 10, which were taken at this speed, are extraordinarily fine cards for that high velocity. The initial pressure is 85.7 per cent. of the boiler pressure, and the mean effective cylinder pressure is over 25 per cent. of the boiler pressure. The engine developed at that speed over 715 indicated horse-power.

The engine is of the eight-wheel type, class A, of the road, with cylinders 18 × 24 inches and driving wheels 66 inches diameter, with large boiler, and very well proportioned throughout. Annexed are particulars of the indicator diagrams.

No. of Card.	Boiler Pressure.	Revolutions per minute.	Miles per hour.	M. E. P.
1.....	145	144	28.59	77.5
2.....	145	144	28.59	76
3.....	140	222	44	50.4
4.....	140	222	44	50.4
5.....	145	192	38	55
6.....	145	192	38	56.2
7.....	135	276	54.76	39.4
8.....	135	276	54.76	40
9.....	140	322	64	35.7
10.....	140	322	64	36.4
11.....	140	270	53.5	40
12.....	140	270	53.5	38.1

Compound Locomotives.

Continued from page 67.

matic starting valve, which admits wire-drawn steam to the low pressure cylinder direct from the boiler, and closes when one turn of the driving wheels has been made. Engines of this kind are working in England, Germany, France, Russia, Spain, India, Brazil, the Argentine Republic, and other countries.

Various other forms of compound locomotives have been built, and all kinds have their own friends and advocates. On the Northern Railway of France, compound locomotives of the Sauvage design have the cylinders arranged in the reverse way to Mr. Webb's, the high pressure steam passing into a single cylinder under the smoke box, and expanding in two low pressure cylinders set one at each side outside the frames. On the same line, they have Woolf four-cylinder compounds, the cylinders being arranged tandem, the low pressure in front. Several engines have been built with two high pressure cylinders outside, and two low pressure cylinders inside, the latter connecting with crank axles. The complication and expense of this method of construction are likely to make the application of the design limited.

As the principal object in applying the compound principle to locomotives has been to effect saving of fuel, special attention has been devoted to the compiling of correct records of the relative cost of service performed by simple and compound locomotives. One cannot examine the returns sent in from the mechanical superintendents of railways in nearly all quarters of the globe, without being convinced that compounds work more economically than simple locomotives; but it is exceedingly difficult to estimate a fair average of the measure of saving. The reports make it vary from 10 to 25 per cent. of saving in the quantity of fuel used. Probably 15 per cent. of saving might be a fair average.

Compounding in itself does not bring about all this saving, as a considerable share of the economy must be attributed to the higher pressures of steam used; but a conspicuous merit of the system of compounding is that it provides the means of taking more of the potential work out of high pressure steam than can be utilized with a simple engine where the facilities for expansive working are so limited.

There are other incidental advantages in the manner steam is used in a compound locomotive, which, no doubt, contribute to swell the saving of fuel. The prevention of condensation and re-evaporation of steam through the avoiding of extremes of cylinder temperature, has been already alluded to. When the steam is worked through two cylinders, there is considerably greater pressure on the pistons when the cranks are near the quarter than with a single cylinder using steam expansively; hence there must be superior rotative effort. The average unbalanced pressure on valves and pistons is also less on a compound than on a simple engine, so that leakage of steam will be diminished. As a compound engine uses 15 or 20 per cent. less steam than a simple engine to do the same work, the boiler has not to be urged so hard to evaporate water; consequently a larger exhaust opening can be used, and as that means a slower velocity of fuel gases, there will be fewer sparks drawn through the tubes.

On the other hand a compound locomotive is more expensive to build than a simple one. If a boiler has to be built capable of carrying a working pressure of nearly 200 pounds, the original cost and the expense of repairs will be increased. The additional mechanism of a compound locomotive must increase the expense of maintenance, and the risk of failure or delay through breakage or the parts getting out of order is greater.

The ordinary American locomotive could be converted into a compound with very little expense or structural change. The Mallet system could be applied by changing one cylinder, and the extension smoke-box would be a highly convenient receptacle for the steam receiver. Although the design of the American locomotive would enable our master mechanics to compound their engines at very little expense, the present system of operating the train service would make a compound locomotive of any existing type unsuitable for doing the work. Economy of fuel in operating locomotives is held to be of much less importance than that of having an engine which will pull the last car possible out of a yard or over a grade. To comply with this demand, our locomotives are built to exert every pound of traction that the adhesion on the driving-wheels makes possible. Our stations and stopping places are so numerous that, unless a locomotive is capable of exerting her full power the moment the throttle is opened, she will lose time on passenger trains, delay traffic with freight trains, and soon become a reproach and a nuisance.

There has been no compound locomotive built that is capable of meeting the existing conditions of American train service. The most successful compounds are very powerful engines when working the steam expansively, but they are incapable of exerting in starting a train, or during a slow pull, the full tractive force that the adhesion admits of. The Pennsylvania Webb compound, with its 14 × 24 high pressure cylinders, and 30 × 24 low pressure cylinder, exerts a starting force only equal to the power developed in the small cylinders. When the train is once moving, and the low pressure cylinder is exerting its power, the engine can do rather more work than a simple engine with cylinders 21¼ × 24 cutting off at three quarter stroke, which provides a high maximum power at the time it is not urgently needed. In the Mallet system it is usual to admit live steam to the low pressure cylinder in starting, and shut it off automatically when the wheels have turned a revolution. This, in practice, would be equivalent to pulling back the reverse lever of a simple engine to the 12 inch notch the moment a single revolution of the wheels had been made. It is unnecessary to dwell on the inconveniences that such an arrangement would cause with our method of handling trains.

If compound locomotives are ever to be used successfully in this country they will have to be designed specially to meet the requirements of our train service. Mr. A. N. Towne, general manager of the Southern Pacific, lately made a statement to the effect that coal for the company's locomotives costs them $6 a ton in San Francisco, and that they have to haul it in some cases thousands of miles to the divisions where the fuel is used. The enormous saving that would result to the Southern Pacific Company and other roads from a reduction of 15 per cent. of the coal consumed will some day bring about a fair trial of compound locomotives in this country. When that time comes an important element of success will be due to the engineer who designs a compound locomotive with simple, efficient and durable appliances for transforming the engine into direct acting or compound acting at the will of the man in charge. American inventive genius ought to be equal to supplying this demand.

Mr. J. N. Lauder, Old Colony, did not think that the compound locomotive could be used successfully to haul American trains unless the rating of the pulling capacity of engines was reduced.

Mr. Coney considered the subject of great importance. He believed that a reduction of 15 per cent. in the fuel used by the locomotives in Massachusetts would mean a dividend of one per cent. more to each company.

Mr. Barnes gave some particulars about the Webb locomotive at work on the Pennsylvania. He held that a compound locomotive equipped with an intercepting valve was as powerful in starting a train as a simple engine, and read an extract from *Engineering* to the effect that a compound locomotive had shown in starting a mean effective pressure of 100 pounds in the high pressure cylinder and 53 pounds in the low pressure cylinder.

In reply to a question, Mr. Barnes stated that the boiler pressure of the engine was 160 pounds.

President Richards read extracts from letters describing the working of different compound locomotives on European railways. The facts stated were to the effect that compound locomotives worked very satisfactorily and effected a saving of from 15 to 20 per cent. in cost of operating.

Mr. Webber spoke of the practice common in the West of making the locomotives pull every car they could move over prevailing grades. Believed that while this was the practice, and where coal was cheap, compound locomotives could not be run successfully.

Mr. Lauder proposed a vote of thanks to Mr. Theo. N. Ely for sending the club a fine photograph of the compound locomotive in use on the Pennsylvania, which was passed.

Freight Car Trucks.

At the meeting of the Northwesterm Railroad Club at St. Paul, April 5, Mr. J. C. Barber of the Northern Pacific read the following paper on car trucks :

The popular freight car truck of thirty years ago was generally known as the "diamond" or "double bolster rigid truck," with vertical motion, but entirely without lateral motion. As they were only intended to carry ten and twelve tons it was not found necessary to fit them with axles having journals larger than 3 × 5 inches, or with journal bearing having an average weight of more than six pounds. The arch-bars or truck frames were of ⅝ × 3-inch iron, secured in position with column and oil box bolts made of ¾-inch. The oak bolsters, as a rule, were not trussed and readily sprung down at centers, throwing the weight of car body almost entirely on the side bearing. However, these trucks were looked upon by railway men as a great improvement in capacity and perfection of construction over many other patterns that were entirely without either vertical or lateral motion. The popularity of these trucks continued up to the time a demand was made for cars which would carry twenty tons, or twice the capacity of the old style. We then soon found that the old "rigid" trucks could not be made to give satisfaction under cars of twenty tons capacity and began to look about us for a truck which would successfully meet the requirements. It was also discovered in carrying twenty tons and over on the old "rigid" trucks that for want of lateral motion the wheel flanges were thrust against the rails by the continual "lurching" of the car body and were rapidly worn out, as also were the collars on journals, the ends of brass bearings and many other parts. To obviate this difficulty the "swing motion" truck was introduced and quite generally adopted throughout the country, as it was, and is now, regarded as a remedy for the defects above mentioned, but there are objections to the "swing beam" truck, and a number of railways decline to use them on account of the increase in cost as compared with the "plain double bolster" or "rigid truck" and the large increase in the number of parts, many of which require frequent renewing; also on account of the additional expense of maintenance in the way of inspection and repairs. While these imperfections are generally admitted, the friends of the "swing beam" truck have always claimed that the saving in "wheel wear" alone would fully compensate for the additional cost.

It seems evident, taking into consideration the number of roads now using the "swing beam" truck, that it has been the most popular truck so far introduced for carrying a load of 20 tons; but now that there is a general tendency and demand for cars and trucks having a capacity of 25 and 30 tons, it seems to be a doubtful question whether a truck of the "swing beam" pattern is safe and practical for such cars on account of the numerous truck hangers, pivots and pivot seats, suspended spring plank axles, friction plates, pins, keys, washers, etc., all of which are continually getting out of order, or, in other words, are "very treacherous," and no doubt have been the cause of a large per cent. of derailments and wrecks. It is a noticeable fact that many of the largest lines in the country who have recently been building 25 and 30-ton cars are using the old style "rigid" truck, with all parts enlarged and otherwise strengthened, as they claim it to be more practical and preferable to the "swing beam" truck, which has numerous parts that "cut out" and break down under cars of 25 or 30 tons capacity. All roads are experiencing more or less annoyance on account of broken-down tender and freight car trucks, and I think we can safely say that seven out of every ten cars received in our repair shops and yards for running repairs are sent in on account of defective trucks. There are various reasons assigned for these defects and breakages; among the most prominent are—faulty construction, poor material, capacity overrated and overloaded, trucks with so many parts that it is impossible to allow inspectors time to examine all, trucks built at car factories of green lumber that warp, shrink and fall in pieces before they have seen a year's service; however, from the fact that these defects and breakages do occur from the causes mentioned, it is time the mechanical departments of railroads awake to the fact that a truck should be produced and adopted which will safely carry a load of 30 tons and have a reserve of 10 tons, and when this is done our freight departments will soon save enough in claims for damaged freight caused by broken-down trucks to compensate for the difference there may be in the first cost of trucks and also avoid numerous delays and annoyances.

Mr. Mathews, of the Ohio Falls Car Company, said, with regard to these heavy thirty-ton cars, it occurred to me as a builder of cars, and traveling all over the country from Maine to the Gulf, that a car of twenty tons capacity, or twenty-five at the outside, should be the limit. The axle adopted now, 4½ inches at the center, and a 3¾ by 7 inch journal, is ample, in my judgment, for any load that ought to be carried in a car. Whenever you increase the length of a car and attempt to increase its capacity you simply add enough material to compensate for the difference; you gain nothing at all. It should be the object, I presume, to so construct the truck and so construct the car as to lighten it and yet carry a heavier load, that is to carry less dead weight in proportion to your load.

If you look over the statistics of freight cars you will find that there has been very little advantage gained over the old ten or twelve ton car of 28 feet, I think. You have done very little beyond carrying the dead weight that you did on the ten-ton car. In order to compensate for that difference you have had to increase the weight of your rails, the number of your cross-ties, the strength of your bridges and the size of your locomotives to carry these extra-sized cars; so that the dead weight you carry and the revenue weight are just about the same in proportion as they were, with the old style car and engine. Then cars used to last from twelve to eighteen years, and I doubt if the life of any car now is eight years. The cost for repairs more than keeps pace with the increased weight. The axles wear out faster, the wheels wear out faster; the same with the boxes, brake-shoes, drawheads; they are heavier and more expensive; so with the links and pins, and all these taken into consideration go far beyond anything that you have gained in making the 34-foot car weighing from 26,000 to 34,000 pounds, in place of the old 28-feet car weighing from 18,000 to 20,000 pounds. We are building some cars for the Pennsylvania road that will weigh 33,000 pounds that carry no more than some of your cars that don't weigh over 24,000. They make no more revenue, the mileage is ¾ of a cent, whether the car weighs 24,000 or 34,000 pounds. I think the axle is now as large as it ought to be, and it is larger than there is any necessity for. The wheel we are now adopting of 600 pounds is too heavy for your 25-ton car by 40 pounds. A 560-pound wheel will last just as long and do as good service as a 600-pound one. You are drawing 320 pounds more per car than is necessary. An axle weighing 365 pounds dressed is just as good, and will last just as long as one weighing 420 pounds, because the wear is on the axle where you have not increased it any, and it seems to me there is no particular necessity for increasing it in the center.

In the model before me (Baxter), I see a particular way of trussing the bolster which I think is one of the most important things about the truck.

I believe that the bodies of freight cars are entirely too heavy, and made too heavy throughout. In a good many instances they are made unmechanically, I think, with a truss above and a truss below, one truss wearing out the other, so that the car sags down in the center and breaks itself to pieces. When it is loaded one way the truss pulls one way, and when it goes back the other truss pulls it the other way. Car bodies, I think, can be readily lightened 3,000 or 4,000 pounds without any detriment whatever to them. The tendency has been, of course, brought about, not by the mechanics, indeed somewhat against their protest, but by the operating department who wanted to get a big car and a big carload to beat its opponents.

Mr. J. O. Pattee, St. P., M. & M., said that only a few years ago freight cars were made of culled lumber and scrap iron, any inferior material being considered good enough for the purpose. The step between construction and the scrap heap was generally very short with such cars. Now that loads from 25 to 40 tons were being put upon freight cars he considered that the strength of parts was not increasing so fast as the loads. Did not think that 600 pounds was too heavy for a wheel that was to carry a 30-ton load. He favored an axle heavier than the M. C. B. standard and a larger oil box.

President Reed said: The dimensions of the axle are most important. We have got to put in an axle that will carry the heaviest load according to the capacity of the car, and the question is if it would pay to have a variety of axles on the road for the different weightcars. You take a 40,000-pound car, put an axle 4 by 8 inches under it, and can you use that axle for any other service afterwards? Then if you put in an axle 4 by 8 what do you gain by making a difference in length and changing the center? The axle is thrown away after it has seen a certain amount of service. I think this is a most important point to be decided by railroad men—what length of axle they are going to use—that is, the length between centers. You can increase the diameter, but you have got to keep the distance between centers. If you take an 8 by 4 or 8 by 3¾ and put in a car with a truck that has been used for a 3¾ by 7, of course it creates a great deal of side play and it will not work right. On the other hand, if you keep the same distance between centers you can use that axle in a lighter service after it is worn. Take it the same way with passenger equipment outside of your freight cars.

Further discussion followed participated in by Messrs. Potter, Hill, Cormack, Barber and others.

Railway Car Construction.

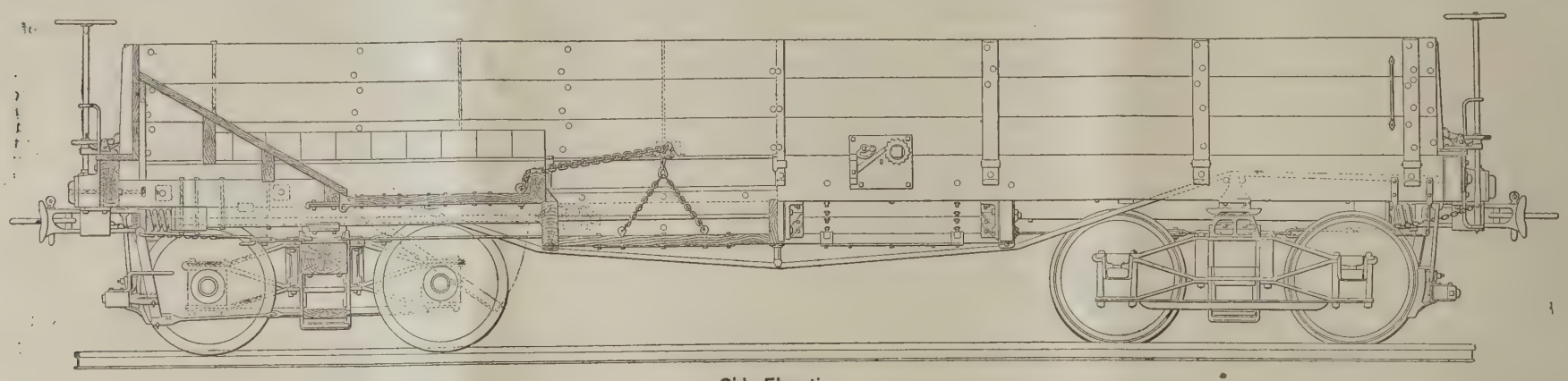
BY WILLIAM VOSS.

Eighth Paper.

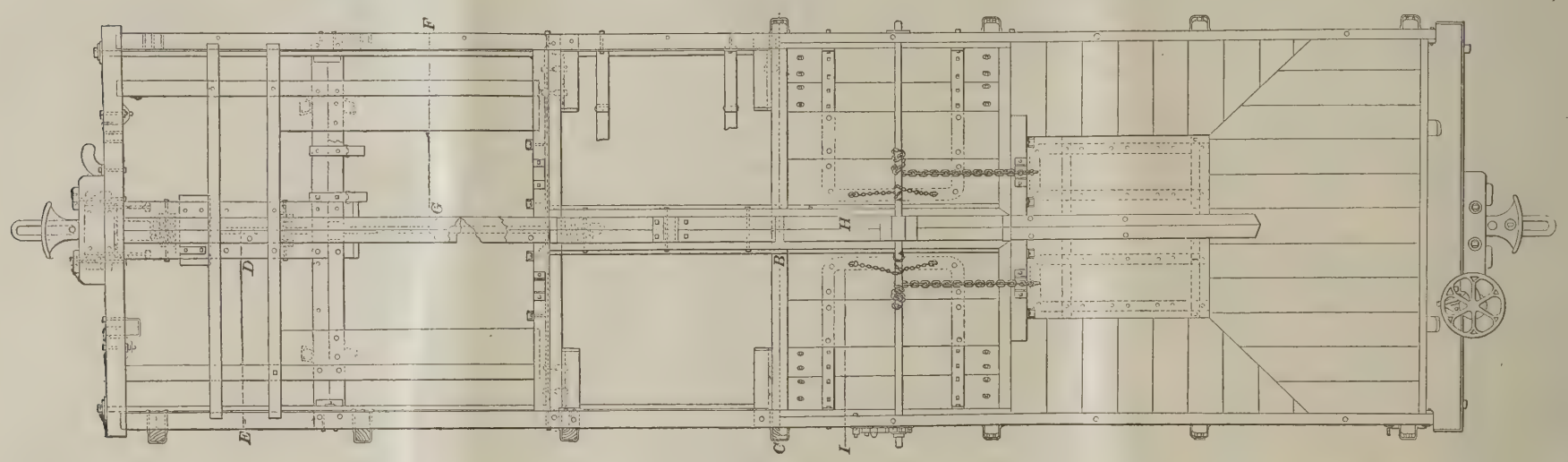
COAL CARS.

Coal is an article that can be and frequently is being transported in all manner of cars, but on roads where it is the chief and almost the only kind of freight hauled, cars are expressly built for that purpose.

wheeled cars would make the box too expensive and too high for existing conditions of the chutes at the mines. To keep the height within practical limits and still retain a single opening for the doors, the plank floor is in some instances covered with light sheet iron, or is replaced by a heavier plate. The iron producing less friction can be applied at a lesser pitch. Those builders who use center sills usually construct these cars with a short incline of the ordinary pitch at each end and apply a system of doors to the intervening space. The construction of the box is also very much different from that in vogue on short cars,

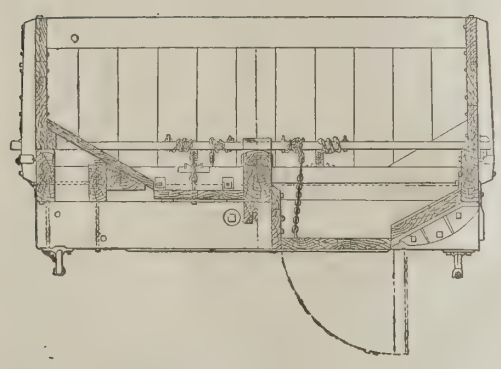


Side Elevation.

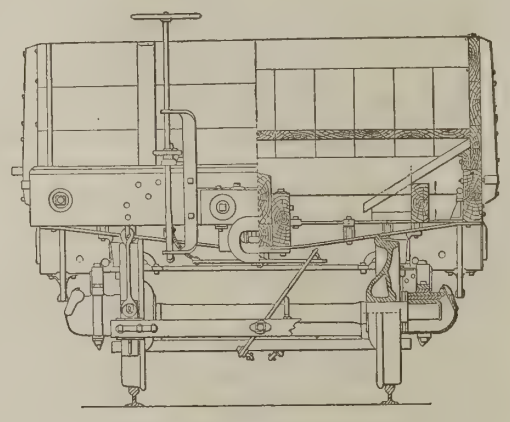


Plan.

Fig. 70



Section through F G H I.



End View and Section through D E.

Fig. 70

first cross-tie-timber only, and mainly serve as a support to the short inclines of the hopper at the sides. They are framed in the ordinary manner.

The number of cross-ties is increased to three, this number being required by the somewhat peculiar arrangement of the drop-doors, of which there are six. These are hung so as to approximately form a continuation of the hopper when they are opened, the load being delivered between the trucks in one direction and between the rails in the other. Each set of three doors is operated by one winding-shaft in the manner shown in the drawings. The details of the shafts, chains, hinges, etc., are substantially th same as those shown in Fig. 69 in the preceding paper, and were fully described.

The incline at the ends is supported by timbers placed across the main frame and bolted to this. That portion of the side-inclines located between the cross-ties is lowered the depth of these and is supported on cast-iron brackets attached to the sides of the cross-ties.

The nature of the car-bottom excludes the use of more than two body truss-rods, but these will carry the load if made of efficient diameter.

The other details will be understood from the engravings.

ORE CARS.

Cars built for the exclusive use of hauling ore are of about the same construction as those built for coal. They are, however, for the same capacity, much shorter and stronger, and this in about the same proportion as the difference in the specific gravities of the two articles. The inclines of the hopper are also somewhat steeper, as ore will not slide as readily as coal, and the sides of these cars are therefore higher. This, again, makes a framed side necessary.

Fig. 71, representing a car of 40,000 pounds capacity, has been selected as a sample of this class. The longitudinal sills are of yellow pine, the end-sills, frame, flooring and siding are of oak. The end-sills are very heavy, as they have to bear the butting strains, the center-sills being cut at the hopper opening. The center of the car is carried by the side framing and a pair of 1¼-inch truss-rods. The king-posts of the latter are of peculiar shape, being attached to the longitudinal sills direct without the customary intervening tie-timber. This is an excellent arrangement where a cross-tie is in the way of the doors, but in this case hardly necessary, as there is abundant space to introduce this timber and the extra expense thereby avoided.

The ends of the box are supported in addition to the bracing in the side-frames by four braces of 4 by 4-inch oak, capped with a piece of the same dimensions, to which the lining of the box is nailed; the feet of these braces rest on the intermediate and center-sills, to which they are framed with mortise and tenon, and also slightly boxed, to guard against end thrust; they are not otherwise fastened.

The space between the end of the box and the end-framing is floored over and serves as a convenient platform from which to operate the brakes; it also has a grab-iron attached to it, and the usual ladders and steps on the side of the frame make it as accessible as the roof of a box-car.

The doors are arranged in pairs, those which are hung next to the trucks being enough narrower to clear the axles of the inside pairs of wheels when swinging open. The

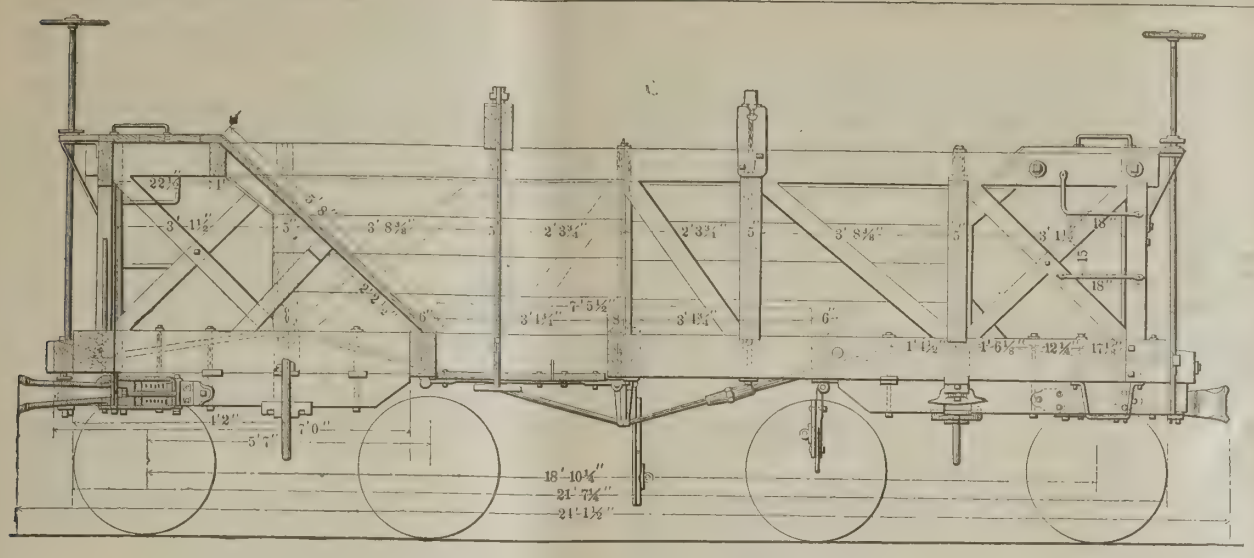
The principal feature of these cars, as previously mentioned, is the peculiar construction of the floor, which is a combination of inclines and trap-doors so contrived that the load is discharged by its own gravity alone. This condition implies of necessity an arrangement of elevated tracks in coal-yards, wharfs and other places for unloading, and the absence of these in all Western States, probably due to the level nature of the country or to the fact that coal is there not so extensively handled, is the reason that this class of cars is in that section but seldom met with. In the East, and some portions of the South, however, it is almost exclusively used for this purpose.

There is so much variety in the manner coal cars are constructed that it is difficult to select for our purpose a sample that will fairly represent the average, if not the best practice. There was practically but very little difference in them, and that in the details only, when four-wheeled hoppers were the rule, but since these have been discarded for cars of larger capacity and consequently of greater length, the difficulties of construction have multiplied, and as in all similar cases, the attempts made to conform to the new order of things have resulted in a diversity of opinions as to how they should be constructed. The upward tendency in the center of the cars is greatly increased by the additional length, and the strength of the frame to resist buffing strains is proportionately reduced. To guard against this some builders increase the size of the side sills and framing and others allow the center or draw-sill to extend through the hopper. Again, the greater length and this difference in constructing the main frame necessitates a modification of the inclines and the doors. The same proportion of pitch as used on four-

the framed sides covered with sheathing having been discarded for the heavy planks and stakes as used on gondola cars, described in the preceding article.

Fig. 70 represents a coal car of 40,000 pounds capacity, designed to meet the above conditions. Its outward appearance is not much different from that of an ordinary gondola car, but there the resemblance ends. The center-sills are placed close together and beveled on their upper edge, so as not to hinder the process of unloading too much. This car being fitted with continuous draw-bar allows the center-sills to be so placed, but when the ordinary attachment is used they must be separated the proper distance at the ends, at least. The draw-timbers can of course be attached to separate pieces of timber bolted to the sides of the sills, but that is not at all desirable, for a number of reasons. To avoid complication should be the first maxim with any designer, and particularly with a designer of draw-gears. The strains should be transmitted to the body of the car in as direct a line and through as few parts as possible. All the intervening members require as strong a fastening as the member receiving the strain first. Unfortunately, the established practice in this country calls for a suspension of the draw-bar below the direct line of transmission of the drawing and buffing strains, the evil effects of which on car bodies any one connected with the repairs of these is well acquainted with; but to alter this and bring the draw-bars in a direct line with the sills is impracticable on cars constructed of wood, besides necessitating a radical change in the present truck and in the freight-house platforms, etc., to meet the lowering of the car-body.

The intermediate sills extend from the end sills to the



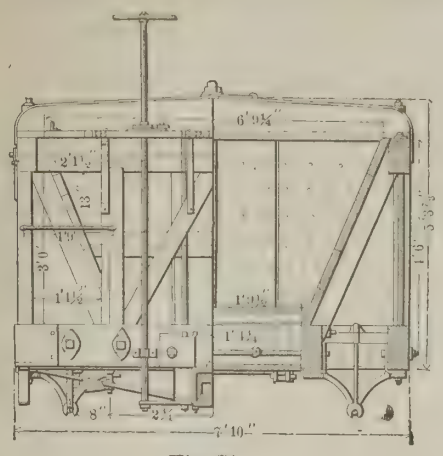
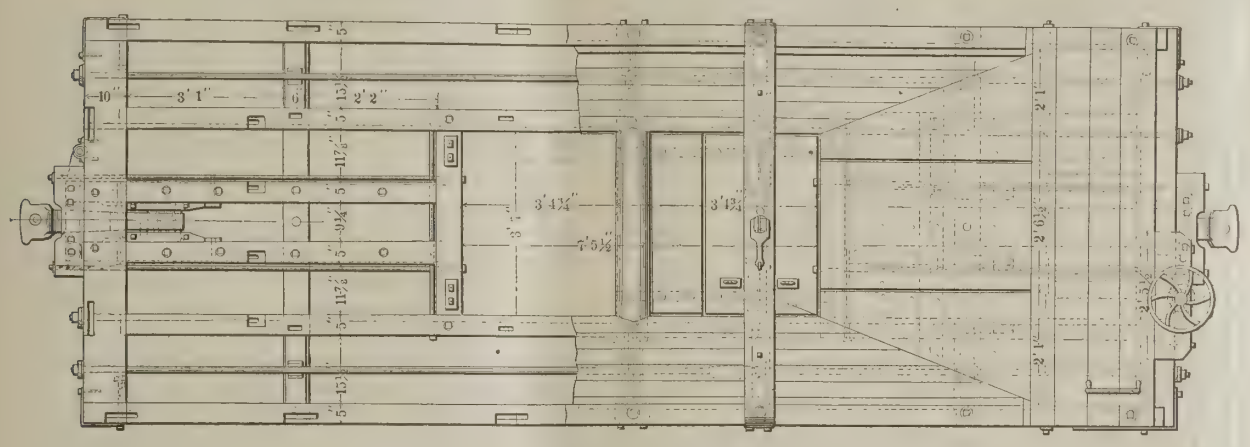


Fig. 71



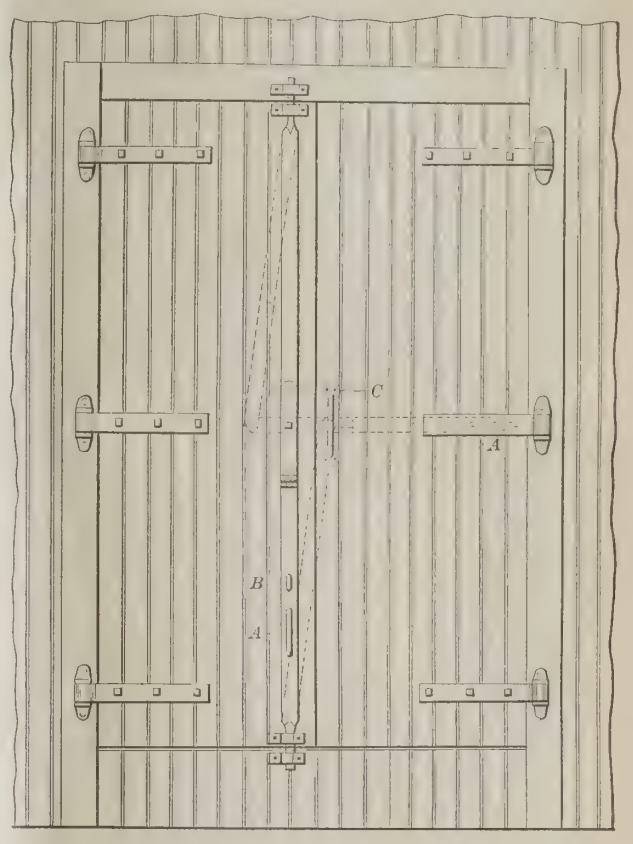


Fig. 73

doors are held up in position by a 1¼-inch rod, in place of the customary winding-shaft and chains. A cross-piece is welded to the lower extremity of this rod and acts somewhat like an ordinary button. It holds the doors when turned in the direction shown in the cut and allows them to drop when its position is reversed, a slot formed by cutting a notch in the adjoining edges of the doors providing the necessary space for the cross-bar to pass through. A square-shaped head of cast iron is keyed to the upper end of the vertical bar, both to form the necessary shoulder and the means for applying a wrench. A short key or wrench hinged to the drop-door cross-beam by a staple serves to lock the bar and prevents the accidental unloading of the contents.

REFRIGERATOR CARS.

The transportation of all perishable articles of consumption for long distances requires a car better adapted for the purpose than the ordinary box-car. It is accomplished by means of refrigerator cars, and the demand for this class of cars is so great that they constitute a large per cent. of the total equipment on the majority of our railroads.

The principal features of refrigerator cars are the same as those of stationary refrigerators. An insulated and air-tight space and a receptacle for holding the cooling medium, which is ice, with or without the addition of salt.

The frame of these cars is constructed precisely the same as that of box-cars, except that the side-framing is perhaps 1 foot higher. The walls, roof and floor, however, are constructed with three or more separate courses of matched boards, so arranged as to form dead air spaces, the outer one of which is frequently converted into a circulating air space by providing suitable openings at the ends of the car through which the outside air is forced by the motion of the train, replacing that which has been heated by contact

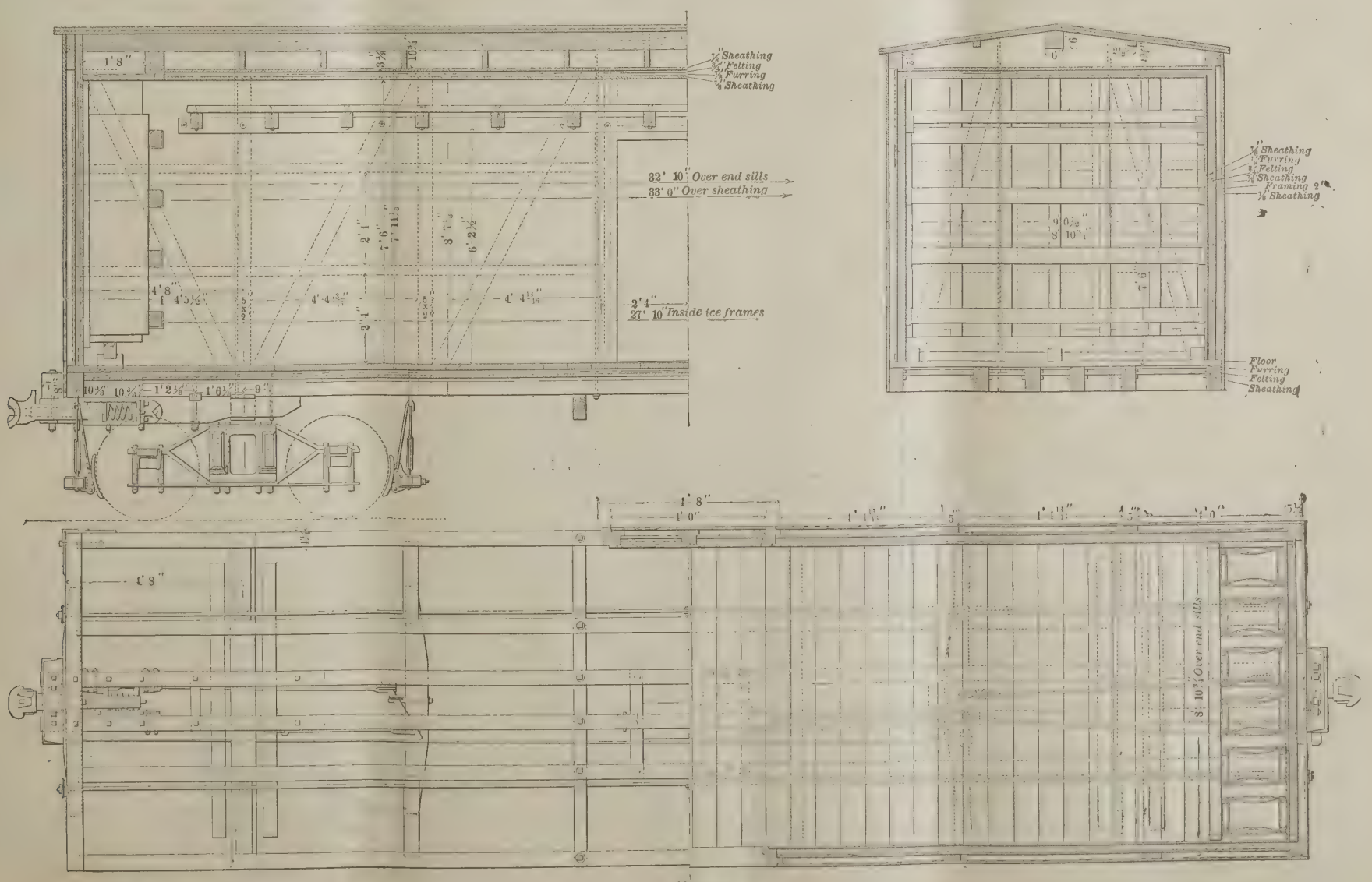


Fig. 72

with the exterior to the sun-exposed sheathing and roofing. In addition to the dead and circulating air spaces some insulating material is used, either paper, felt, rubber or cork chips, which is attached to the inside of the lining in one or more layers.

As dressed meat is one of the principal products now demanding refrigerator-service, these cars are usually fitted with a suitable rack to suspend it from. This rack consists of a series of oak slats 1½ inches thick by 2½ inches deep, with the upper edge rounded to fit the portable meat-hooks. The slats are placed parallel with the sides of the car, and are bolted to 4 by 4-inch oak supports, placed across the car at intervals of 2 feet, and which are in turn supported by a pair of sub-plates substantially fastened to the side-framing.

The loading space is made accessible by a pair of folding-doors located on each side. A sliding-door would be of but little service in excluding the air, but is sometimes used in addition to the folding doors mentioned. The folding doors are made of the same thickness and with the same number of air-spaces and insulating sheets as the walls of the car. The edges of the doors and jambs are beveled to afford a ready release when it is desired to open them. They also have a recess or groove cut in them, which is filled with curled hair or some other flexible substance and covered with canvas, the whole forming a cushion which renders the doors practically air-tight. The doors are hung with three 16-inch strap or specially forged strong hinges. A variety of contrivances are employed for fastening and locking the doors, the one shown in Fig. 73 being, perhaps, as well if not better adapted for the purpose than any of the others. A bar, jointed as shown, is pivoted to the left door by a bolt; the wedge shaped ends engage with flat staples secured to the casing immediately above and below the opening. Similar staples, acting as guides to the bar, are attached to the door itself. The operation is as follows: The handle *A*, which is hinged to the center portion or cross-bar, is pulled outward enough to disengage from the staple *B*, which is attached to the lower half of the locking bar for the purpose of introducing a lock or seal. The handle is then turned to the right to the position indicated by the dotted lines. This movement extracts the locking bar from the staples and leaves the doors free to move. An inward pressure on the handle *A* pulls the left-hand door open, the handle acting as lever for which the usual handle *C* attached to the right-hand door furnishes a convenient fulcrum.

The receptacles for holding the ice are placed, 1st, under the roof, from which place the most perfect and uniform distribution of the cooled air is effected; 2d, at the ends, either parallel with the sides of the car, or, as in the latest practice, across the ends. The overhead ice chamber is objectionable in that it necessitates a somewhat higher car with the center of gravity somewhere near the roof, and in case of leaks or stoppages of the waste-pipes and conductors is liable to seriously damage the contents. The ice-tanks as now commonly constructed are placed at each end in series of six, are of galvanized sheet iron, and have a circular or rectangular cross-section. The object of separate tanks is to get as much conducting surface in as small a space as possible (the ratio of the surface required to the cubic space available for the load is as 1 to 2), and also to more conveniently and accurately guage the temperature for the different kinds of products in transit. All the tanks have to be charged only when the car is to be used for dressed meat, which requires a temperature as low as from 30 to 35 degrees, while from 45 to 50 degrees is sufficient for dairy produce and vegetables, and a charge of two or three tanks at each end of the car will produce this. One drip-pan is used in common by each set of tanks, and the ordinary drip or discharge pipe with a water-seal is connected to this. The tanks are charged from the roof. The openings necessary to accomplish this are provided with doors constructed similar to those on the side. A light board cover is placed over these to exclude rain and snow.

We have received the annual financial statement of the Kinzie Street Railway Department of the Young Men's Christian Association of Chicago, prepared by Mr. William Cook, general secretary. The rooms and the work carried on in them are supported by contributions from the Chicago & Northwestern Railway Company, and by the Chicago, Milwaukee & St. Paul Railroad Company. The rooms are very humble compared to most of the places where the Young Men's Christian Association has control, but, nevertheless, the attendance is good and the work done is of a highly beneficent character. We feel assured that the two companies named do not spend any money that pays them better than the disbursements needed to keep the Kinzie street rooms going. There train men find rational, attractive and elevating amusement for hours of leisure, and the place acts as an excellent counter attraction to the resorts that vitiate so many train men who, by being so much away from home, are peculiarly open to temptations to indulge in practices that unfit them for their responsible duties. Men who spend their leisure time in railroad reading rooms are not liable to cause accidents through be-muddled heads, and it would pay more railroad companies to provide resorts of this kind for their men.

Hassman's Tire Heating Apparatus.

The portable tire heating apparatus illustrated in the annexed cut, for which we are indebted to the *Locomotive Engineer*, was invented by Mr. William Hassman, master mechanic of the Richmond & Allegheny Railroad. Mr. Hassman writes to us as follows about the device: This machine was created by me to fill a most urgent need about a year ago, and has been in such successful operation since then that I concluded to have it patented, and now address you with a view to its notice by your journal.

Any master mechanic or foreman of locomotive repairs that has an old main air reservoir, two ¾ in. globe valves,

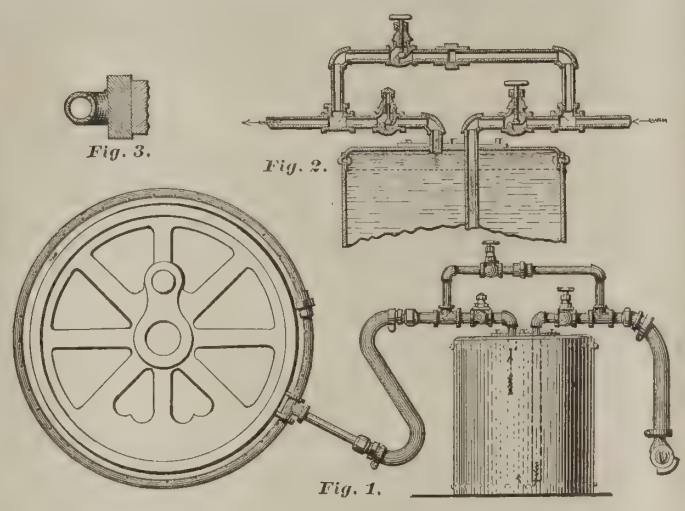


Fig. 3. *Fig. 2.* *Fig. 1.*

one ¾-in. check, a few feet of ¾-in. iron pipe and 6 or 8 feet of hose can make one in a couple of hours. The filling is of excelsior, quantities of which go to waste from the store room.

I have used it not only for removing and adjusting tires, but have straightened the frames of locomotives that have been in collision, in position. Foot and running board braces have been treated in the same way. I also expect to use it for brazing and numerous other jobs that occur in repair shops, for which heat is required.

By using it, I, as well as the Chesapeake & Ohio people, have removed tires 1½ inch thick in from 12 to 15 minutes.

My mode of procedure is to have an engine having an air pump under steam close to the engine to be operated upon, connecting the reservoir by the usual train brake coupling, then start the pump, working the pressure up to from 20 to 30 pounds. Open the valve, and in case the air becomes too highly carbureted temper it with the other valve; the latter has a tendency to force the flame, giving an intense quick heat. I have shinned tires of an engine, using its own pump and boiler.

Misplaced Skill.

The men who run eastern railroad repair shops could often learn useful lessons by watching how work is done in similar shops in the West. Mechanics do not relish the idea of looking westward for instruction, but it might often be done with profit. The ornate elaborations of outside finish, that were common on motive power a few years ago, are almost extinct, but there is still to be found in many quarters a tendency to put work where it is wholly unnecessary. Some words which "Chordal" wrote about workmen apply pretty aptly to many men in charge of workmen, and might bring works meet for repentance if they were seriously considered and given personal application. Chordal says:

"Some machinists when they speak of a good workman mean a man who is fine, close and accurate. This is not correct one-half the time. There are just as good men working on rough, portable engines as you can find in the shops. They are skillful men. But put them into shops building tools and they are gone; fact is, they should not have come. In the same way the tool man isn't worth his salt on portable engines. He accomplishes nothing, and is hard at work all the time. Some folks think a job can't be done too well. Nonsense! There is more work done too well than too bad. It is no trouble to go and contract for good work and get it; but it is hard to get rough work properly done. Some one has said that dirt is simply matter misplaced, and I say that bad work is simply labor misplaced. If I saw a man painting a sewing machine shuttle with coal tar, I would say he was botching the job, and if I saw him putting a crocus finish on a hand-car crank, I would say the same thing.

"If a man grinds up a sugar mill roll on a Morton Pool machine, he makes no better job of it than if he had taken a single roughing cut over it. A skilled workman is one understanding the tricks and art of his trade. If he has the judgment and common sense which tells how and where to apply his skill he is a good and valuable workman. If he does not know how and where to apply his skill, he is not a good and valuable workman. There are more bad skillful workmen than good ones, and the thing must be equalized by supervision. The foreman is to supply the judgment, and the workman the skill. A skillful foreman is generally a bad foreman, for he has judgment mixed up with his skill, and supposes that every other skilled workman has judgment also. He will give a man a job, and leave him to his own devices, and if the job is badly done he will lay it to the man, because he knows he could have done it properly himself. A foreman with more judgment and less skill would advise such a workman to quit the machine trade and go into the post-hole business."

He will not Attend the Convention.

"It is drawing on towards the time of the conventions," said the Wayfarer to Master Mechanic Nemo the other day, "and I hope you will attend one or both of them."

"What is that you say Mr. Wayfarer?" exclaimed the head of the mechanical department of the X. Y. & Z. Railroad. "Have you been through these shops and suppose that I could go away from here for two weeks, and let everything go to wreck and ruin? Why, sir, I have not been but three days away from this office in fifteen years, and that was on company's business."

"Go to the conventions indeed" repeated Mr. Nemo two or three times, as if weighing and relishing the absurdity of the suggestion. Then, as if roused to action, he jumped up and said, "Come and I'll show you what I have got to do instead of going to your conventions."

Then he rushed me the second time through the shops and roundhouse and pointed out the miserable condition of many of the engines, and gave me the assurance that when other master mechanics were enjoying themselves at Niagara Falls he would be doing all that mortal man could perform by personal supervision to get some of these engines hurried through the shop. From there he dragged me through the car shops, and pointed out sundry cars that were undergoing a renovating process and informed me of a formidable list of others which ought to go through a similar ordeal before the summer rush of business called everything into service. And after he had fatigued himself expatiating on the difficulties of making performance keep pace with the demands of the repairing service, he triumphantly inquired, "Now, do you think it is likely that I shall go to the conventions?" And I conscientiously answered, "No."

But as I walked through the shops and noticed that most of the tools were run far below the economical speed, and that the cuts taken were scratches beside the cuts taken in shops that made little claim to being progressive, I could not help thinking that the company might not be the loser if the master mechanic took a couple of weeks annually to see what was going on elsewhere. I also thought that if Mr. Nemo had been in the habit of annually talking over the business of running the mechanical department of a railroad with other men engaged in the same occupation, he would have received suggestions which would have benefited himself and the company he tried so zealously to serve. A natural result of this wider intercourse would have been the convincing of this man that he might safely and judiciously leave certain details of work to his subordinates to be carried out. This would have given him time to attend to duties more important than that of being his own roundhouse foreman and car inspector.

Mr. Nemo is a representative man, and his class take great credit to themselves for taking no holidays and for attending to every detail of their business themselves. That sort of egotism is very comforting to those who indulge in it; but in nearly every case it is unfortunate for the companies they serve. I have never yet found a master mechanic or car builder so overwhelmed with business that he could not go away for a holiday, but what the company's business was mismanaged. It is the small caliber men whose business is too great for them who cannot find time to attend conventions or railway club meetings, and a general manager has reason to fear that he has got an incompetent man, when the head of his mechanical department proclaims that he cannot spare a couple of weeks annually to attend conventions or to see what other men in his line are doing.

The Milwaukee, Lake Shore & Western made a better showing in net earnings last year than any of the neighboing roads. The operating expenses were reduced $195,000 below what they were the previous year without reducing the condition of the property. A material part of the satisfactory condition of things was due to the able way in which Mr. John Hickey, master mechanic, managed the operating of the rolling stock.

So indestructible is African teak wood that vessels built of it have lasted fully one hundred years. This wood is one of the most remarkable employed in the industries, for its great weight, hardness, and durability, its weight varying from 42 to 52 pounds per cubic foot. It works easily, but from the large quantity of silex contained, the tools require to be hard, and even then are subject to severe wear. It also contains an oil which prevents nails driven into it from rusting.—*The Engineer.*

Communications.

Oil-Box Covers.

Editor National Car and Locomotive Builder:

The writer being interested in all improvements in railway appliances, especially those that lessen operating costs, read with much interest the article in your April number, headed "Oil-Box Covers." There is perhaps nothing in connection with a railway car that is so important a factor in creating expense in the operating department of a railroad as coverless oil-boxes admitting sand and dust, destroying the journal-bearing, the journal itself, and causing hot boxes, consequent delays, etc.

It is astonishing to estimate the amount paid annually for new oil-box covers, and to observe the large percentage of journal-boxes that are running without covers, or have covers that are worthless, hanging on by one hinge or half broken.

What is required is, as a first requisite, a cover that will not be too costly. Secondly, one that can be made to apply, if possible, to any of the various styles of boxes now running. Thirdly, one that will prove durable enough to withstand the careless and rough usage it receives from the inspector's hammer.

While I am not prejudiced in favor of the "M. C. B.," "Hewitt," "Fletcher," or any other style or design of box-covers, I think what is required must embody all of the above conditions. We must bear in mind that there are about ten millions of boxes now in use on the rolling stock of the railways in the United States, and it will require something aside from the adoption of the "Hewitt" or any other cover now in use to take care of all these various boxes.

Let us get a durable material in the manufacture of covers, and if springs are used, let them be properly tempered, as would be required in any other spring, and not cut in lengths and riveted to the lid without any temper whatever, as is now almost invariably done; then we will hear less complaint of springs taking permanent set, and causing open boxes, rattling, etc. Manufacture the coming cover of good material that will enable the use of light weight, and thus prevent the wear on the hinge bolt.

While I am aware that the "Hewitt" box is in use on many thousands of cars, I must take issue with "Member of M. C. B. Association" when he asserts this cover is used on more cars than any other, if not all other, covers. I agree with "Member" that when the issue does come, the "Fletcher" style of cover will be a leading factor.

The "Hewitt" cover is not without its objections. The cost of royalty has exceeded the cost of other durable covers furnished complete. It is an expensive casting to make in comparison with any other style. I now refer to the box as well as the cover, and great care is necessary to secure the merit claimed for the cover and not meet the objections pointed out by "Member;" and we would not condemn him for his candor in referring to these objectionable features of the "Hewitt" box and cover.

The writer has seen innumerable cases, from some cause or other, probably wear of sides of the cover in the guides, where there was a space of an inch at the top of the cover, admitting dust and injuring the journal and journal-bearing. Again, in case of end wear, no provision is made for the thrust of the journal, and many of the guides for the cover are burst off and the cover falls off. Many such boxes can be seen at any time on the roads using the "Hewitt" cover. Another serious objection is, that if the "Hewitt" cover should be adopted as a standard by the association, it will require new boxes to replace those already adopted, as well as new boxes to replace those where the "Fletcher" is now in use.

I feel that in so important a matter as the adoption of a standard cover that the "M. C. B." standard cover, as well as the "Fletcher," should have due and careful consideration. There is no question but a light, neat, cheap and durable cover can be produced for either of these styles of covers.

The objections "Member" makes to the "Fletcher" style of cover, viz., that the spring loses its temper when the box gets hot, and the cover drops open, I would say that the box must get very hot indeed to draw the temper of the spring, or else the spring must have little temper—perhaps, like most of the box springs, made of steel wire rolled cold and not tempered at all.

The Pullman Company uses the "Fletcher" cover, and has its boxes made as they should be, and, in fact, as they are made by all the railway companies that I know of who use "Fletcher" covers; the edges of the lid fit into a recess top and bottom of opening of the box, and there is no occasion for the cover dropping down, even if the spring has lost its temper.

While on this subject, I would refer to the wrought steel covers of the Morris Box Lid Company, manufactured by the A. French Spring Company, Limited, Pittsburgh, Pa., whose well-known reputation as manufacturers of springs is a sufficient guarantee that the covers are properly made. In the "Fletcher" cover manufactured by them they dispense entirely with the spiral spring as well as the malleable iron plug, it being so formed as to combine cover and spring in one piece, of crucible cast steel, and the cover being tempered in oil will stand rough usage from the car inspectors, is light and durable, and fits snugly into the recesses in the box, while its cost is less than malleable iron.

We trust that the committee at its meeting will give the subject thorough consideration, and that this one troublesome feature of our rolling stock equipment may be improved and perfected, thus resulting in an immense saving to our railway interests. OBSERVER.

Behavior of Iron in Solidifying.

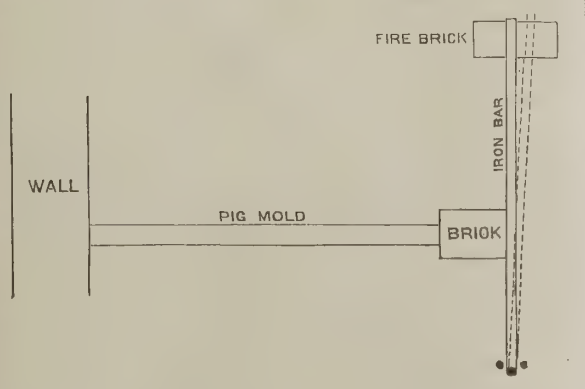
Editor National Car and Locomotive Builder:

Referring to the article with the above title, in your April issue, your correspondent is undoubtedly correct in saying that "taking the body of the casting as a whole, there is no such state existing as 'moment of solidification.'" For the "whole" casting the process of solidification is a gradual one, and with some irons it is much more gradual than with others. But it does not follow from this that a casting "will from the moment the mold is filled or poured, till it has reached, as a casting, its lowest point of temperature, be all the time constantly shrinking and contracting so as to occupy less space." If it did, in every casting, and especially in every one of any considerable size, the center ought to be the most intensely compressed part, as it is the last to reach the "lowest point of temperature," and therefore should show the finest and closest grain. But we do not find it so. The center always shows the largest and most open grain. If, however, as each successive portion becomes solid, its contraction is resisted and prevented by an expansion of each successive portion in becoming solid, the open grained center is easily and satisfactorily explained.

In my impromptu remarks before the N. Y. R. R. Club, I could probably have made my meaning clearer if I had stopped to explain that "the moment of solidification" is the moment when any portion of a casting becomes solid. At that moment that portion of the casting expands, and it is probable that contraction of the whole casting, under ordinary circumstances, does not become apparent until this expansive force is spent. In confirmation of this statement I beg leave to call attention to the following facts:

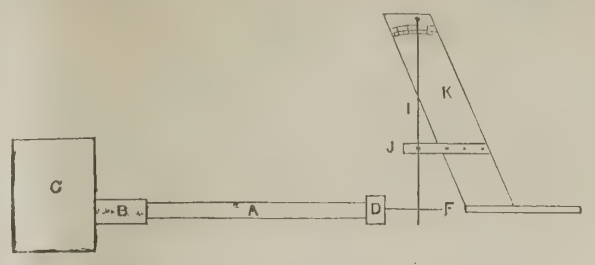
1. Several years ago I had occasion to meet this question practically. To test the matter, I prepared two molds of exactly the same size in every particular. One mold was filled with iron at a white heat, directly from the cupola. The ladle was then allowed to stand until the rest of the iron had cooled down so as to be only just fluid enough to run freely, when the second mold was filled. Both were left undisturbed in the sand until they were perfectly cold. Then they were cleaned and carefully measured. They were found to be of exactly the same dimensions in every particular. The shrinkage of each from the size of the pattern was exactly twenty-five one-hundredths of an inch in 12 inches.

2. On another occasion, an ordinary pig about 8 feet long was molded in open sand, so that one end of the mold was closed by a solid brick wall and the other end by a fire brick, free to move in the sand. Against this fire brick a bar of iron, 6 feet long and 1½ inches square, was laid, one end being pinned to the ground and the other resting on a fire brick. The fire brick connection with the mold was at about 2 feet from the pivoted end, as shown in the annexed diagram.



This apparatus was prepared impromptu, and, as will be seen, was exceedingly crude. I expected no satisfactory results. On pouring the pig, however, every one was surprised after a few minutes to see the bar of iron gradually move on the supporting fire brick, as indicated by the dotted lines, until it lay one-quarter of an inch from its original position.

3. On a more recent occasion, the following experiment was made with an apparatus more carefully prepared, as shown below. A pattern, *A*, 4 feet long, 3⅞ inches deep and 2¾ inches wide, was molded in open sand, one end of the mold being closed by the fire-brick *B*, and the other end by a piece of gas carbon, *D*, which was suitably connected with a small battery and galvanometer. The fire-brick *B* rested at one end against a block of iron, *C*, weighing about half a ton. The gas carbon block *D* was carefully secured in the sand, so that the weight of iron in the mold should not be sufficient to move it. The stand *K*, bearing an arm *J*, on which the pointer *I* was delicately pivoted, was then adjusted, so that the needle *F* should press against the gas carbon *D*, and the pointer stand at zero on the scale. The long arm of the pointer



was 24 inches, and the short one 6 inches long, or, as 1 to 4. The scale was graduated to $\frac{1}{16}$ of an inch.

A, casting; *B*, fire brick; *C*, weight; *D*, gas carbon block; *K*, stand; *I*, pointer; *J*, supporting arm; F, adjusting needle.

The mold was filled with very fluid hot iron in seventeen seconds, and then the following results were carefully noted:

For more than 1 min. after the mold was filled pointer stood at zero.						
At 1 min. 30 sec.	"	"	"	"	moved 1-16	"
1 min. 50 sec.	"	"	"	had moved	⅛	"
3 min. 10 sec.	"	"	"	"	¼	"
5 min. 20 sec.	"	"	"	"	⅜	"
8 min. 5 sec.	"	"	"	"	7-16	"
11 min. 30 sec.	"	"	"	"	15-32	"
12 min. 5 sec.	"	"	"	"	½	"

From that time the pointer stood perfectly still at ½ inch until 25 min. 15 sec. after mold was filled, when the galvanometer showed that contact with the gas carbon was broken and shrinkage had begun.

4. I have made several other equally convincing experiments, but the length of this article forbids that they should be repeated here.

5. Long before these experiments were instituted the fact that iron follows essentially the same law as water in solidifying was well known and published. I need cite only two authorities. Prof. Edward Turner, in his "Elements of Chemistry," published in Philadelphia in 1835 by Desilver, Thomas & Co., says, page 20, "Water is not the only liquid which expands under reduction of temperature, as the same effect has been observed in a few others which assume a highly crystalline structure in becoming solid; fused iron, antimony, zinc and bismuth are examples of it." Prof. Thomas Graham also, in his "Elements of Chemistry," published in Philadelphia in 1843 by Lea & Blanchard, says, page 385, "Iron expands in becoming solid, and therefore takes the impression of a mold with exactness."

6. As the observation of this law was the basis upon which my experiments leading to the successful development of the contracting chill for-cast iron car wheels was based, I am persuaded that it will lead to many other practical results of great importance. This is my apology for trespassing upon your space and calling special attention to the matter. JOHN R. WHITNEY.

The Coupler Question.

Editor National Car and Locomotive Builder:

My attention has been lately called to a circular from the secretary of the Interstate Commerce Commission in which he desires certain information upon the coupler question, both general and specific. The subject suggests to my mind the fact that at one time I took a lively interest in this problem, and it may be of interest to review a little in detail the course the question has taken; it certainly is the most complicated mechanical problem ever presented to the railroads. In the vicinity of 1880 it had become the general belief in the public mind, that the large number of accidents to railroad employés which occur in coupling and uncoupling freight cars, could be generally diminished by the adoption of suitable automatic appliances. The railroads from motives of self interest, and stimulated to action by a wish to procure the most perfect safety appliances, in order to prevent or reduce if possible the liability of danger or accident, and cut down their operating expenses, were trying various automatic devices. After testing several kinds, the Boston & Albany Railroad Co. in 1881 equipped between 40 and 50 stock cars with the Ames Automatic Coupler.

The L. S. & M. S. Ry. Co., some time previous to this date, had equipped several cars with this coupler, and it promised good results. These couplers were all put on under the care and supervision of Mr. Ames, the inventor, and the result of these trials under his watchful care were very successful in the service where they were placed, resulting in the adoption shortly after of the coupler by the Boston & Albany Railroad Co. and the Vanderbilt systems.

It had been a serious question with many thoughtful men whether it was possible to utilize some one of the automatic couplers. It was not without the keenest interest and the gravest apprehensions that the experienced railroad men consented to the mixing of the different new automatic couplers in trains with the old couplers, believing that in the transition from the old to the new, the danger and accidents to train men would be largely increased. Practical trial in use gives abundant proof that the fear was founded upon the solid rock of good judgment. Experiments and trials continued with different results until the spring of 1884, when the movement was urged before the Legislature of Massachusetts by impulsive enthusiasts, who evolved out of their own mind automatic contrivances which in theory could be operated without the aid of human power; but the actual conflict

with the actual appliances has shown us what must be the conclusions reached. May 8, 1884, an Act requiring railroad companies to use safety couplers on freight cars was passed by the Legislature to take full effect March 1, 1885. In this act the Railroad Commissioners were required to prescribe, after examination and test, the form and kind of coupler to be used. This action took the matter from the railroad companies' hands. The Commissioners were now called upon to act, and with a strength of purpose before which Samson would shudder were he living, they invited a general exhibition and test of the automatic car couplers at Boston in September, 1884. This thorough investigation of the subject resulted in the selection by the Commissioners of five couplers, no two of which would couple automatically together, nor could they be coupled together at all without serious danger to life and limb. This action was taken by the Commissioners to comply with the law which the State Legislature of Massachusetts in its wisdom made, delegating to them the power to select and prescribe the couplers to be used. Did the Commissioners act wisely?

The automatic coupler question was now fast being developed (or otherwise) by the action of the Massachusetts Railroad Commissioners through these investigations. It was supposed that the object of the commissioners was to select an automatic car coupler or couplers, so constructed that they would interchange automatically with each other, and thus prevent the necessity of trainmen going between the cars to couple or uncouple them.

The question now presented a dilemma. If the railroads did not select one of the five couplers prescribed, they were liable to the law; if they did, they were liable to select a coupler which would not couple or uncouple without great difficulty with those in use and those likely to be adopted, and great danger and trouble in running trains was anticipated. With these perils in view, the managers of the New England railroads delegated the mechanical men to call a meeting, the object of which was to endeavor to reach some conclusions as to which of the five couplers the meeting would recommend for adoption. The meeting was called at Boston, Dec. 17, 1884. The subject, in all its bearings, was fully debated, and resulted in recommending, by a tie vote, the Ames and the Cowell, neither of which would couple together, for adoption by the New England railroads. This action did not result in any material benefit. The earnest effort of the delegates to overcome the evil of having five different so-called automatic couplers, none of which would couple automatically with each other, was a complete failure, and a single standard for the New England States was abandoned, and each railroad was left to pursue its own course. We have seen that the railroads of Massachusetts were subjected to the alternative of selecting from five so-called automatic couplers, prescribed by the Commissioners, no two of which would couple automatically together, and that the railroad companies were not able to fix upon any one of these five couplers as a standard. From time to time it was announced that one company had adopted this and another company that coupler, until quite a large number of two or more of the different kinds were placed in service. After a time the Commissioners were prevailed upon to increase the number already prescribed, multiplying the difficulties and adding to the number which would not couple one with the other. The automatic coupler question was now being agitated throughout the country, involving almost every railroad community. It was, therefore, necessary, that some appropriate means be used to accomplish the purpose of an automatic coupler by the railroad companies. In September, 1885, forty-two couplers were tested at Buffalo; the test was made under the supervision of the Master Car-Builders' Executive Committee, and perhaps the trial was the most important ever held, as all those engaged in the experiments were practical mechanical experts. This trial resulted in selecting twelve from the forty-two couplers, for further trial; they were to be placed upon ten cars each, and the result of this further trial reported to the M. C. B. Executive Committee prior to May 1, 1886. Mr. F. D. Adams, J. S. Lentz and Secretary Forney were the committee. These trials were made, and to-day, it is safe to say, that nearly all of these devices are consigned to the home for abandoned couplers.

The Master Car Builders at their convention two years ago recommended the use of a vertical plane or Janney type coupler, but this action is nugatory in consequence of the fact that although a majority of the votes which the delegates were entitled to cast were secured, a majority of the delegates personally were opposed to the coupler. The delegates being entitled to as many votes as the number of cars represented by them, the advocates of the coupler were able, by securing the votes of some of the larger roads, to carry the Janney coupler plan, but it is said, and I believe it to be true, that some of those who voted for the coupler only voted for it believing a trial would soonest secure the failure of the movement. For the past two years these couplers have been put in service by a few railroads. The foregoing leads us up to the inquiry, What has been accomplished? Let us see. In the first place, we find that a number of years prior to 1884, when the law was passed in Massachusetts compelling railroads under the jurisdiction of the State to use safety couplers, the railroads had experimented with scores of automatic couplers and were reluctantly forced to abandon them on account of the danger resulting from their use. In the ordinary handling of the cars they were broken, and difficulties in coupling one kind with another could not be overcome and danger and accident was the result. The Ames, however, seemed to be the only coupler that survived the shocks of actual service. Its good behavior can be accounted for to a certain extent. It was applied to a class of cars that are run generally in a solid train and therefore did not meet with the disadvantage of being handled in mixed trains where the inequalities of some some three or four hundred different coupler attachments would have tested its lack of universal adaptation to the numerous cases. When the Ames coupler was adopted by the railroads named, all new cars built by them and for them by contract shops had the Ames automatic coupler specified. The couplers were made by different parties, and the lines of the original coupler were not exactly followed, resulting in much annoyance and trouble in consequence of the difficulty in making the couplers of one railroad couple with the other. This experiment demonstrated one thing, and it is this: The coupler adopted must be very simple in its construction, so that if exact lines are not followed by the different railroad companies it will not interfere with the perfect operation of the coupler. Up to 1884 the railroad companies had made unusual efforts to secure an automatic coupler without any practical success. In 1884 the policy of forcing the adoption of an automatic coupler was declared in the act of the Massachusetts Legislature, and we have seen how that steps were taken by the railroad companies to put the plan into excecution as rapidly as possible. These efforts were watched with great interest by the public, and with solicitude by the railroad companies. If a single argument were needed to point out the lack of wisdom in the management of this difficult question, that argument is found in the mere summing up of the tangible results. Cars equipped with the various couplers commenced running in interchange traffic, and it was found—as it was seen by the railroad men on the start—that no two cars with the same kind of couplers were likely to come together, thus completely losing any advantage which might have resulted from the use of a single automatic coupler. It was also found that the new automatic couplers were weak in many parts, and sadly unfitted to couple to the old style couplers, and nearly impossible to connect one of the new automatic couplers with another of a different make. Trains were breaking apart, men in consequence were injured, and the whole experiment resulted in such an increase in danger and accidents to train men that the Commissioners, no longer able to resist the fact that the movement had jeopardized life and limb, and seeing the danger inflicted upon the train men, have permitted the railroads to act in the matter as seemed most desirable, and the whole movement rests and is abandoned to-day so far as any positive action by any authorized power is concerned. The danger, accidents and expense resulting from this movement by the legislatures of the different States can never be truly estimated. The Master Car Builders' type of coupler has been in service and tested, and is pronounced by practical men as dangerous and weak in construction, as all the swivel head vertical hook couplers are, although comparatively few are in service. the call for parts for repairs is steadily increasing, and many of the large railroads advocating and voting for this type of coupler, after a thorough trial, have abandoned its use on account of the grave disadvantages encountered, and would now vote against its use. It must be admitted that the question stands about where it did when the move first commenced, so far as reaching a standard is concerned, terribly magnified by the increased number and diversity of patterns, and in proportion to the increase has the danger multiplied. For the purpose of arriving at the opinions of train dispatchers and trainmen, interrogations were sent out asking which in their judgment was the best and safest automatic coupler in use, and their opinion as to the advisability of adopting some automatic coupler, and the uniform answer was, "Don't want any automatic couplers; they are all men-killers. Give us the common Safford coupler."

This so far is cool encouragement to the automatic coupler. I have, for the purpose of comparison, drawn from records the number of common and one kind of automatic coupler broken for one month at a single point on a small road. The number of cars equipped with this automatic coupler must have been comparatively small compared with the number received. The records lead to results as follows:

Number of automatic couplers disabled, and it must be remembered that this represents only one kind, 165; number of common old style couplers disabled, 35. It is pretty clearly proved that at present at least it is wise to abandon the effort for a standard automatic coupler, at least until some trustworthy automatic device has been perfected which is known to be able to stand the trials of actual service.

When such a coupler is produced it will be heartily accepted by all those interested in train service. The object then, primarily, is to diminish the number of accidents to trainmen caused by coupling and uncoupling freight cars. This being the case, what are the obstacles in the way? Judged by the position taken by the trainmen, the first obstacle seems to be the public. It is crying for an automatic freight car coupler, which up to the present time no one seems to have produced, which fills the full schedule of requirements and lessens the danger to trainmen.

It has taken six thousand years to produce the telephone We are living among things very imperfectly known. The danger of producing an automatic coupler equal to the emergency seems so remote that there is great danger that the next decade will find us stuck in the precise spot we have been wallowing in for the past twenty years. Let us consider for a moment the condition of this question during that period. Has there been any such marked advance that it would have been inconvenient to have had a single standard, instead of the three hundred or such a matter in general use?

No one need have any unreasonable alarm in reference to possible improvements which would make it unwise to adopt a standard.

The importance, safety and economy of a single standard coupler are so obvious that no one familiar with the details will for a moment dispute its necessity. That the action of the Railroad Commissioners in so many States in prescribing different automatic couplers has greatly increased the danger to trainmen is the unanimous opinion expressed by men of experience, and that a want of a uniform standard is the chief cause of the danger in coupliing and uncoupling cars. Now that the impatience and bad judgment of the advisers of the automatic coupler movement has subsided, the opportune moment presents itself to the railroads to effect a movement which shall immediately result in the adoption of a single standard freight coupler, and crush out the remaining obstacles and bring this automatic coupler question to a sudden collapse. Will the railroad companies do it by their master car builders in convention? There is now no longer any doubt about the wisdom of employing a coupler as a standard which has stood the test of service for years, and receives the approval of almost every operator in train service.

The Safford common coupler for safety to train men, durability in service, and economy in the matter of repairs and universal adaptability, is unquestionably the most perfect coupler in use for freight cars. This can be adopted without interfering with the question of progress in the line of an automatic freight-car coupler, for when that coupler appears which fulfills all the requirements of complete safety to human life, this coupler will certainly present no more obstacles in the way than does the three or four hundred in use to-day. By the adoption of any one single standard of the most improved now in use there would be a tremendous stride in the line of progress. It is clear, then, that a single standard can be adopted without detriment to any one, but with immense advantage to every one interested, both in the saving of life and limb, as well as untold saving in the expense of maintaining the diversity of kinds now in use. The obstacle in the way of this result is opinion, prejudice, or self-interest, and to harmonize individual opinions, prejudices and self-interest is impossible. These opinions are all made up, signed, sealed, put away in the safe, locked up, and the key and combination *both* thrown away, hence cannot be changed. The question is a national one. Cars owned by every railroad are interchanged as freely as though they had one common ownership, and the power to accomplish the looked for result rests with the United States Government, and that Congress by the advice of the proper committee of experts would act wiser in connection with this matter, as now understood by railroad men, than the States have done, is not for a moment doubted.

In connection with the coupler question, and of equal importance, is a standard height of coupler from top of rail to center of coupler, a standard of ladder rounds and grab irons as to position and shape, and a standard size for running boards. In fact, a complete standard of wearing parts is highly desirable. These matters are of imperative importance. Many standards have been adopted by the Master Car Builders, but their power reaches only the point of recommending the adoption of standards. A Commissioner of Standards with an Executive Board should be appointed. The Commissioner should have authority to prescribe standards subject to the approval of the board. The Commissioner should be an expert mechanic. The board should consist of men from the managing, mechanical and transportation departments. The use of the standards prescribed and approved should be enforced by law. NEW ENGLAND.

The Portland Locomotive Company are driven with orders. Among their jobs are three locomotives weighing about forty-five tons each, two of which will be run on the P. & O. division of the Maine Central R. R.; a six-ton tilt-hammer for the Cape Ann Forge Works, this being the third built for that company; a seven-ton condenser, a seven and a half ton cylinder, and a two ton air pump for the new Portland and Boston steamer now being built at Bath; pulp grinders for the Otis Falls Pulp Co.; three rotary furnaces for S. D. Warren & Co., and car wheels and other small castings for railway and steamer construction without number.

An order has been received at the Altoona shops of the Pennsylvania for 15 class "A" anthracite locomotives. It is stated that another order will soon be given. The company are preparing to build a compound locomotive suited to the requirements of their service.

Railroad Notes from Chili.

Mr. C. W. Rickard, master mechanic on the Iquique Nitrate Railways of Chili, writes us:

In answer to your expressed desire to know something of this railway working, etc., I would say the two terminal points are the ports of Iquique and Pisagua, Chili. From both terminals very heavy grades have to be contended with, the heaviest being nearly 5 per cent., until the coast range of hills is passed, which is 18 miles from each port. The main line between the ports is 125 miles long, but the road has a good many branches running to the different works where nitrate of soda is manufactured. The rock bearing this material is found along the base of hills on the pampa over a vast extent of territory. Nitrate, with a small proportion of ores and borax, is the freight hauled down, and coal and general merchandise up. Water is found on the pampas at depths varying from 14 to 150 feet, according to locality. But on account of deposits of salt and other minerals through the strata of sand none of the water is very good for boilers, and some of it is very bad. The water used in the ports is brought in water-boats and costs the company about 1¼ cents per gallon. This, with coal at about $7 per ton, will give you an idea of operating expenses. The water contains so much soda and other solids in solution, that an engine will not work but one day without blowing off and refilling. As we are generally short of motive power, and engines arrive late at night and must leave early in the morning, they are blown down and refilled with cold water within from three to five hours. The results of this need not be explained to any locomotive man, but when boilers become leaky the item of water they lose on the ground has to be considered here where water costs the price named.

I have proposed having a tank in roundhouse here, and arrangements for blowing the steam from all the engines into it; then run off the water from boilers just before filling, and fill them at once with this hot water. I think this arrangement would soon pay for itself, and have been anxious to try it, but the company does not wish to go to the expense. The saving would be great on boiler plates, in labor and in preventing the hot plates hardening the deposit left from the water into hard scale, as well as a saving in fuel, the difference between raising steam from cold or hot water, considering that the steam used for heating it first is now blown away into the atmosphere.

ROLLING STOCK.

Of this there is a variety on this road, with the usual result of a lot of extra trouble and expense in keeping it in repair.

The company is now getting a standard flat car from England, but I have noted one very weak point about them—a shock that the draw-bars will generally stand will almost invariably break the center beams of the trucks.

Not long since a "tail end" collision occurred near here by some runaway cars, and in looking over the cars to see what damage had been done, I found nearly every one of the new cars had center beam of trucks broken in center, while some old American flat cars mixed in among them, that have seen many years of service and look as though they were about ready for "scrapping," were almost uninjured, excepting a couple of draw-bars knocked in.

We have 57 engines on this road comprising twenty different classes from six different builders, viz., Sharpe, Stewart, Fairlie Stephenson, Fowler, Rogers, and Danforth & Cook.

All our engines carry side tanks, and no tenders. The English engines coming from the makers with them stand the variable load better than the Rogers, as the latter were built with tenders, and bought second hand by this company. The extra weight put on the frame results in breakage and many extra repairs being required. While on this subject I will mention two more cases that have come under my observation of changing parts of engines from the builder's dimensions, all of which have given bad results. On a road in Peru I saw a Danforth & Cook engine that had 18 × 22 inch cylinders, 48 inch wheel, changed to 24 inch stroke, which resulted in springing the guide yoke by the extra force exerted on it enough to put both pump plungers up through the top of the pump barrels. The engine was towed in and extra braces put from guide yoke to barrel of boiler. Another was a small Rogers engine, having the tender on extension of engine frame with a four-wheeled truck under tender. The latter was enlarged to carry nearly double the water and coal that the builder designed the truck for, and the engineer told me it had not made a cool trip in a year, and used a "bucket full of tallow a trip" in the four boxes, the bearing being too small for the load put on them.

I have seen good results from putting 6-inch larger wheels under an engine having 48-inch wheels, mogul class, which is the only case I have noticed in this country where changing builder's dimensions has turned out well.

From what I have read of the extension front ends, I think they would be a good thing for this road. This saltpeter in sacks, hauled in open cars, if set on fire by a spark, takes the car load, car and all, as water put on it only causes a series of explosions, which scatter it in all directions, often setting other cars on fire by that means. The exhaust pipes used here are the single long pipe, with the old style smoke arch, which, although not equalizing the draft in the flues, still serve the purpose of throwing few sparks. I am very much interested in your paper, especially parts pertaining to modern improvements on railways in the United States, of which we see very few here in this out-of-the-way place. I can see that the interchanging of ideas among master mechanics is resulting in a great deal of good.

The Master Mechanic had His own Way.

"I see that you are trying to keep up the master mechanics' end when the operating department sits down on him," remarked a well-known supply man to our Wayfarer the other day in the rotunda of the Grand Pacific Hotel, "but there are some mechanical men who do not need any prop, no matter who tries to put pressure upon them."

"I have traveled on a good many different lines," continued the supply man waxing confidential, "and I have had to do business with a great variety of patrons, and no class of men have treated me better than master mechanics, but there have been exceptions to this, bad exceptions," he said with a pensive sigh, as a far-away look gathered in his eyes.

"You know Mr. Blank?" he went on, naming a well-known superintendent of motive power. "You do, well, and like him? Why, now, now that's funny, for I always thought that Mr. Blank treated me more meanly than I have ever been treated by any one. I am not stuck on Mr. Blank."

"How did it happen, do you say?"

"It was this way. Mr. John Smith, a friend of mine, had got deeply interested in the Awltraps Automatic Mechanical Train Brake, and he worked on me about the tremendous success the brake was bound to attain, and the millions of dollars it was certain to put into the pockets of the stockholders, that I caught the brake fever and agreed help to boom it. The first thing to be done, he explained, was to get the brake applied to a few cars belonging to leading roads. The rest of the race was then won. The brake possessed such transcendent merit that it would force its own way into popularity.

"I was well acquainted with several railroad managers, and Mr. Smith's idea was that I should go direct to them and get orders to equip cars with the brake. I had known Mr. Brown, general manager of the A., B. & C. road for years, was on intimate social relations with him, in fact, and to him I went to get the first lot of brakes applied. This is the road, as you know, where Mr. Blank is superintendent of machinery. Well, when I unfolded my business, Mr. Brown said that he would ask Mr. Blank to examine the brake.

"'Ask Mr. Blank to examine the brake!' I exclaimed. I can assure you, Mr. Brown, it requires no examination; it only wants the order to apply it to ten of your cars, and I hope our long friendship will be sufficient guarantee that I would not offer you an article which is not perfectly reliable.

"'That is all right,' returned Mr. Brown. 'I have perfect confidence in your brake, but you understand that railroad business must be conducted systematically through the heads of the different departments, and you may rest assured that a letter from me will ensure your brake getting a favorable reception in the hands of Mr. Blank.'

"No reasoning, or further appeal on my part could alter Mr. Brown's way of doing business, and he is a first-class railroad man we must all admit. I accepted the letter to Mr. Blank, and went out to the shops and delivered it next day.

"Mr. Blank received me very kindly, as we had done some business together before when I was in the car wheel line, and he was not aware that I had changed. Then I handed him Mr. Brown's letter, and he read it carefully over. On finishing it he looked across at me reflectively, and I concluded that he was favorably struck with the contents of the letter, but he said nothing and proceeded again to read the letter with careful deliberation. After getting through with it he quietly rose, and pointing out of the window asked if I saw that vacant spot of ground unoccupied by broken castings, ancient forgings, decaying brake beams and other familiar articles that ornamented the purlieus of the office. I admitted that I perceived the vacant spot, and Mr. Blank said: 'If I had my way, I would erect five scaffolds on that spot. Four of them I would keep busy hanging car coupler cranks, and the fifth one I would use for ridding the world of men who carried round models of mechanical train brakes in their satchels!'

"I kicked on the treatment I had received from Mr. Blank, and went to Mr. Brown and related my experience with his superintendent of motive power. He laughed till I got mad, then he pretended to be sorry and said he would talk to Mr. Blank, but I never got the brake on a single car of their road.

"No, sir. I have no use for Mr. Blank, not much!" repeated my friend with emphasis, and he wiped the perspiration from his brow, as he reflected on the exciting events of his past life.

The Maine Central Railroad Company will build one hundred box cars and three hundred freight cars the coming season.

Some Defects in Axles.

BY GEO. L. FOWLER.

It seems strange that in all of the reported discussions on the subject of a suitable axle for a 60,000-pound car, little or nothing has been said regarding the material and manipulation during the process of manufacture, while the whole stress has been laid upon the suitable dimensions and proportions. It is, of course, taken for granted in these discussions that hammered wrought iron is the material in question, except in a few instances where steel is brought forward. But every car builder who has had to do with axles, knows that there are as great differences existing between makes of wrought axles as between cast-iron car wheels. Why, then, is not the subject discussed? Do the gentlemen think that the drop test will protect them and lay bare all dishonesty?

Some years ago the rage for cheapness brought axles upon the market that had been hammered from old rails, but they proved so poor that their manufacture has been stopped. These axles probably stand at the bottom of the list of poor material. But even the higher grades are not exempt from criticism. Some short time since, having occasion to use some finished wrought iron, slightly smaller and about the same length as a M. C. B. axle, we conceived the idea of re-hammering some old axles and finishing them to our purpose. Before purchasing the old stock, however, we paid a personal visit to the Master Car Builder under whose care these axles had been run, and were assured that they were of first class quality. They had never given any trouble, had never broken, and had been made of carefully selected scrap by a thoroughly reliable maker.

These axles were then drawn out and finished. Of the whole lot there was not one that did not develop old sand seams and cold-shuts on being cut into, and 20 per cent. had to be discarded on account of the large size of the defects. Under these unexpected developments, and as we were in a hurry, we decided to take some of the old axles and turn them down to size without rehammering. Here worse defects were found, and one-half of all the axles tried were discarded. It may be added that nothing was discarded except for defects such as would secure the condemnation of any axle in any shop where the slightest attempt was made to select good clean stock for journals.

This experience merely goes to show that while the outside of the original axle had been worked sufficiently to give a clean surface at the wheel-seat and journal, the core was in a decidedly seamy condition. The hammering had been concentrated where it would tell, and the rest left in an unworked condition. There is little doubt but that this is more frequently the case than buyers imagine. There is a desire to rush out work, and the metal is hammered after it is too cold to weld, and in subsequent heating is not raised to a temperature high enough to destroy the cold shuts, while the sand holes show an even greater carelessness.

Every mechanic knows the value of the working metals, and it is nowhere more desirable than in the manufacture of axles, especially if steel is used. As an example of the efficacy of reworking, we may be permitted to cite a case of boiler steel. Some time since one of the steel boilers on a British cruiser began to crack about the rivet holes, and these defects soon became so bad that the boiler was removed. The shell was 16 feet in diameter and one inch thick. A test piece was cut from this as well as from another boiler of a different make, but which had developed no defects. The two pieces withstood the same tensile strain, showed the same limit of elasticity, both could be bent double cold, and their chemical composition was identical. What was the matter?

The bad sheet was then re-rolled down to one-half inch in thickness, was put into another boiler, and never afterward gave any trouble. The whole difference between a sheet of first-class quality and one that was worthless lay in the difference in the amount of mechanical work expended upon the two. So in axles, while dimensions must be very carefully weighed and considered, the working of the metal and the way in which it is put into shape as well as the original selection of the scrap must be carefully attended to. It is almost needless to add that the only way to insure that the work will be properly done in all cases is to have inspection on the spot at the time of manufacture.

Among orders for the building of rolling stock placed during last month were twelve locomotives and 1,200 freight cars by the New York, Ontario & Western. The Union Pacific contracted for the building of fifteen passenger cars, and the Georgia Central placed the same number.

The Louisville Reality & Improvement Company, capital stock, $1,000,000, has been organized. They have bought 1,200 acres of land and have consummated arrangements for the erection on their lands of the large steel car works, to be built by the American Fire-proof Steel Car Company having capital stock of $1,500,000. They have the assurance of the location of steel bridge works by the Chicago Steel Bridge Company, of Chicago, Ill., and other manufactories to be moved from the North.

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EDITORIAL ANNOUNCEMENTS.

Advertisements.—*Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING COLUMNS. *The editorial department will contain our own views and opinions; and the rest of the reading matter, aside from advertisements, will be such as we consider of interest to our readers.*

Contributions.—*Articles relating to railway rolling stock construction and management, and kindred topics, by those who are practically acquainted with these subjects, are especially desired. Also early notices of changes in railroad officers, organizations and names of companies.*

Special Notice.—*As the* CAR AND LOCOMOTIVE BUILDER *is printed and ready for mailing on the last day of the month, advertisements, correspondence, etc., intended for insertion, must be received not later than the 25th day of each month.*

Surface and Interior Density of Steel.

A law suit recently led to a series of very carefully conducted experiments to test the comparative hardness of the outside and inside of steel rails. The facts brought to light ought to bear directly on the investigations that a committee of the Railway Master Mechanics' Association are conducting to find out the relative value of thick and thin tires. *Engineering News* gives an account of the tests which were conducted by Messrs. Hunt & Clapp, of Pittsburgh Testing Laboratory, and we present the record condensed as follows :

A series of tests were cut from the various rails in such a manner that the strips were alternately, in each series, from the metal at the surface of the rail, and further strips cut from the interior of it, each being about $\frac{1}{8}$ inch thick. Various tests were made upon these strips, to indicate the relative hardness and density of the steel at the surface of the rail and in the interior.

1. *Tests of Specific Gravity.*—The specimens cut for specific gravity were from strips $\frac{1}{4}$ inch long, $\frac{1}{8}$ inch thick, and $\frac{1}{4}$ inch wide, and were taken to represent as nearly as possible the steel upon the outside surface of the rail and the interior of the rail opposite to it, and the specific gravities were compared in 17 series or pairs of test pieces. These tests show that the average of 17 tests taken from the inside of the various rails give an average density of 7.83, and the average of 19 strips taken from the outside of the rail give an average of 7.8186, showing the average density out of the 36 specimens to be more dense in the inside of the strips by .0114. Grouping in series, 13 of the series show more dense interior specimens, while only 4 show more dense outside specimens. It is noted that small variance in specific gravity in steel indicates very large differences in the actual density and hardness of the steel, and that results varying in the second decimal place often show very remarkable difference in the quality of the steel.

2. *An Attrition Test.*—An attrition test was made by taking strips cut from the outside and interior of the rail and rubbing the one specimen against the other. In one series of strips cut from the outside of the rail, the specimens were rubbed against each other, and the loss in weight noted after a given large number of strokes. Similar specimens, treated in exactly the same way with the strips cut from the interior of the rail, rubbing against each other, were tested. In this way tests were treated of the 63 pounds per yard. Johnson curved rail, which gave a total loss of $3\frac{11}{16}$ ounces specimens from exterior, after 9,800 strokes, and, under the same treatment, strips cut from the interior of the rail lost only $\frac{15}{16}$ ounces. Specimens were cut from a Johnson curved rail of 82 pounds per yard, which, after 22,500 strokes, lost $23\frac{27}{32}$ ounces. Specimens cut in the same way, and under the same treatment, from the interior of the rails, lost only $6\frac{7}{16}$ ounces. Specimens cut from the outside surfaces of the Wharton curved rail, and rubbed against each other, lost $9\frac{9}{16}$ ounces; whereas, specimens cut from the same rail, with surfaces from the interior of the rail rubbing against each other, gave a total loss of $5\frac{3}{8}$ ounces. In the case of each of the three series, those from the Johnson 82 pound, 63 pound, and from the Wharton rail, lost considerably more under attrition from the strips cut from the outside surfaces of the rails than those cut from the interior of the rails. A further test was made from strips of the 82 pound Johnson curved rail, the rubber being with an interior face rubbing against a strip with an exterior face. After 5,125 strokes, the loss upon the rubber with the interior face was $1\frac{3}{8}$ ounces, and of the strip rubbed with an exterior face, a loss of $2\frac{3}{8}$ ounces; again showing the most wear upon the strips cut from the exterior face of the rail. These attrition tests all indicated that the strips cut from the interior of the rail are harder than those cut from the exterior.

Further tests were made by grinding, but the results were not satisfactory, and appeared to prove nothing. Every mechanic who has used a grindstone or an emery wheel can readily perceive that the amount of metal taken off different pieces by grinding would depend so much on the changing surface of the stone or wheel that a fair test of density could not be easily made in that way.

Chemical tests of the pieces taken from different parts of the rails were also made. It was found that the percentage of carbon and manganese was considerably smaller in the outside than in the inside pieces. This reduction is attributed to the action of the oxygen of the air upon the exterior surfaces of the steel while it was highly heated. The difference with steel rails having 0.30 to 0.45 per cent. carbon varied at least 0.023 per cent.

From what has been said, it will be seen that the testimony of the experts goes to show that steel rails are more dense and consequently liable to wear better in the inside than in the outside. As steel tires are nearly of the same material as steel rails, and as the method of manufacture is not greatly different, the logical conclusion would be that the physical condition of a steel tire is very much the same as that of a steel rail. If this conclusion is found to be correct, the prevailing belief that a steel tire is softer towards the core than on the outside is a popular fallacy. There appears to be good evidence that thick ties do not give such good comparative mileage as thin ones, but if this is proven to be true some other cause than defect of material must lead to the rapid wear. The conclusions reached by Messrs. Hunt & Clapp in respect to the density of steel rails were practically the same as those reached by the engineering department of Watertown Arsenal two years ago, when they made tests with a pyramidal punch acted on by a given pressure to ascertain the relative hardness of the outside and inside of steel tires. They found that the inside was the most dense; but little attention was bestowed upon the report of the experiments, which appears in the Railway Master Mechanics' Annual Report for 1887, for the reason that most of the people who were interesting themselves in the subject, had already made up their minds that the inside part of a tire was softer than the outside, and they readily assumed that the tests could not be correct. Opinions on this question need to be carefully reconsidered. It is by no means the first time that foregone conclusions have been erroneous conclusions, proving highly pernicious to the interests of the parties concerned having most at stake. It would certainly be a good plan for the committee of the Master Mechanics' Association having the subject of tires under investigation, to get tests of steel tires made similar to those followed in testing the density and hardness of steel rails.

Power of Compound Locomotives.

The paper on Compound Locomotives read at the last meeting of the New England Railroad Club by Mr. Angus Sinclair, which is published elsewhere in this issue, excited considerable discussion in the meeting and out of it. Nothing pleases the author of the paper better than bringing out anything to arouse discussion about matters pertaining to railroad rolling stock which are in dispute, for the exchange of ideas resulting therefrom is certain to make some one the wiser, and the more that the subject of compound locomotives is discussed, the more our railroad men will know about a type of steam engine that ought to be better understood than it is. The mistakes that men fairly well informed about compound locomotives may readily fall into is well illustrated by the position taken by one of the speakers at the club meeting, who insisted that a compound locomotive developed as much power for starting a train as a simple engine. A mistake of this character is so liable to happen in the course of a verbal discussion, where there is not time to make calculations, that we would have passed the incident over without notice had it not been that two railroad journals, the *Railroad Gazette* and *Railway Review*, have taken up the subject editorially, and informed their readers in effect that the author of the paper on Compound Locomotives did not know what he was talking about when he made the assertion that compound locomotives did not exert the power in starting a train or on a slow pull usually possessed by a simple locomotive. In contradicting at the club the statement that compound locomotives were deficient in power at starting, Mr. Barnes quoted from an article in *Engineering* as the foundation for his belief. The article cited as authority described the working of a Worsdell locomotive with high pressure cylinder 18 inches and low pressure cylinder 26 inches diameter. The boiler pressure was 160 pounds, and when the intercepting valve closed in starting a train the high pressure cylinder showed a mean effective pressure of 100 pounds and the low pressure cylinder 53 pounds. At this rate the combined pressure exerted by the steam on the two pistons would be 53,493 pounds, and would be equal to a mean effective pressure of 105 pounds on the two 18-inch high pressure cylinders, that pressure being 65 per cent. of the boiler pressure. The Worsdell engine that was brought into the discussion, with the exception of the large low-pressure cylinder in place of an ordinary cylinder, is in all respects the same as the builder's standard 18 inch passenger engine, and is required to perform the same work. Now compare the admitted performance of the compound locomotive with a simple engine having two 18-inch cylinders. After the first revolution of the wheels the cylinders would receive 65 per cent. of the boiler pressure. This would be 91 pounds mean effective cylinder pressure with an engine carrying 140 pounds on the boiler. An American locomotive which developed only 65 per cent. of the boiler pressure in the cylinders in starting could not put into motion 75 per cent. of the freight trains that have to be hauled, and a majority of through passenger trains could not be started without the help of a pusher. Of course, at high speed, the compound, which is nominally equal to a simple 18-inch cylinder locomotive, would develop greater power than the latter, which is an important element in its place; but for American railroad service, full power at starting is of greater importance than surplus power at speed.

The statement made in the paper on compound locomotives that no engine of this type yet built will handle American trains satisfactorily cannot be refuted by a mere contradiction. We invite the attention of engineers to the subject with the full assurance that they will find the averment to be substantially correct. Compound locomotives work satisfactorily on European railroads because the prevailing train loads are much lighter than ours, and consequently the difficulty in starting is not so great. The information respecting the working of compound locomotives supplied by foreign engineering journals is very valuable, but it needs to be properly digested before it can be safely wielded as arguments in a discussion. There are a great many things about the working of a compound engine that are difficult to comprehend, and we commend our contemporaries to study the subject a little more before they pose again as authorities and captious critics.

Discipline in Railroad Operating.

In a paper, "Discipline," read by President Gadsden before the Railway Superintendents' Association, he strongly advocated the levying of fines as punishment of any serious breach of discipline by railroad employés. His plan of punishment is to fine one dollar for the first offense, and if an offense is repeated by the same man to increase the exaction one dollar till the fifth offense, when suspension is inflicted.

In case of injury to property happening through the carelessness or neglect of any employé, the offender will, at the discretion of the superintendent, be required to make good the damage done. Throughout the paper, where this method of enforcing discipline is unfolded, Mr. Gadsden displays an earnest desire to deal fairly, leniently and justly by the employé, while holding over his head a light rod that will inflict punishment sufficient to show that necessary rules cannot be violated with impunity. The safe operating of railroads requires that employés should be compelled to follow faithfully certain rules; but the punishment of virtual violations of rules is one of the most difficult and delicate matters that railroad officers have to deal with. No iron-clad rules can be followed safely or judiciously in the punishment of violations of rules. The plan followed by Mr. Gadsden may work satisfactorily on the Charleston & Savannah, where their author is superintendent; but in many districts their enforcement would bring more tribulation upon the company than upon the violators of rules. More than one railroad company have learned that they are not legally empowered to levy fines, and that money kept back as such may be collected in the courts; and most companies employing men belonging to labor organizations have found out that the practice of requiring employés to settle for damages done to property by neglect or carelessnes is considered a *casus belli* with most of the brotherhoods.

Violations of rules frequently happen from very different motives. There are certain men who are constantly breaking rules because they are naturally opposed to anything representing authority. Such men refuse, without previous notice, to go out when called at a time when men are scarce, because they derive a sneaking satisfaction from the fact that the officer responsible for getting a substitute for the offender may "snort" before he succeeds. Another man breaks rules in a good-natured, thoughtless way, because he feels certain that it will not matter and no one will be the wiser. When sent out to flag a train he goes ten paces past the way car and sits down to be ready to return promptly and prevent delay when the train is ready to start. He is zealous to get in on time, and forgets that the train is at the foot of a grade in a position not easily seen, and that No. 5 accommodation is ready to pull out of the side track three miles back. A third man is anxious to obey the rules to the letter, but he blunders into forgetfulness and violates unintentionally rules that are liable to cause damage and suffering. Still another man is so industriously employed all the time scheming how he can best save himself from doing anything which can possibly be avoided, that no rule is permitted to interfere with his first object in life, which is devotion to securing every possible personal comfort. It appears to us that these different types of men, and many others with other idiosyncrasies, who habitually violate rules, need treatment suited to each particular case, and that can only be managed by sharp discrimination on the part of the officer in charge. Fortunately, the great mass of railroad men keep fairly well within the rules that common sense and experience have shown to be necessary for the safe operating of trains. The individuals of the small minority that habitually endanger the lives of others by failing to obey necessary rules, do not deserve much pity when the axe descends which sends them into other employment.

Economy in Oil.

The lack of data regarding the wear of journal brasses, commented upon in our last issue, is more than paralleled by the absolute ignorance regarding the true efficiency of the lubricating oils that are used upon them. The average purchasing agent seems to think that he has done his whole duty when he has bought the lowest priced lubricant and waste upon the market and squeezed the last cent in discount out of the seller; provided he delivers at the same time an article or articles that will not allow the journals to get hot.

There is another element, however, that is never taken into account in the purchasing of supplies; it is the coefficient of friction developed by the oil between the journal and the brass. We will suppose that an oil is offered whose coefficient is .10. It is evident that it will be cheaper, at even a higher price, than one which develops a coefficient of .16, when regarded solely from the standpoint of ease of draught. Again, it is well known that the higher the grade of the lubricant the smaller the quantity required for a given service, so that it possesses this two-fold advantage over its cheaper rival in that less of it is required and the hauling is made easier.

But the purchasing agent will say that so much oil is wasted, and the men in charge of the oiling of the cars are so careless that the theoretical saving in quantity disappears and all oils stand on the same basis. Granted that this be so, our purchasing agent still shrugs his shoulders and doubts that any difference in oil can add to or detract from the hauling power of the locomotives.

It is now our turn to turn theory into practice. A number of years ago a certain man took the contract to furnish oil, waste and brasses for all of the coal cars on a trunk line. He believed that the best was the cheapest. In all his purchases, therefore, he bought only the best of supplies. He attended to the business in person, and throughout the whole time of the duration of his contract not a train was delayed by a hot box, while the standard train hauled by the locomotives in the service rose from fourteen to nineteen cars. Unfortunately for the railroad company, he made money out of the job, and the purchasing agent found it out.

This wily official therefore persuaded the railroad authorities that what man had done man could do, and that the company could purchase its own supplies and save the profits of the contractor. So when the contract expired it was not renewed, and the era of cheap oils and waste once more set in. As a result, in less than three months, or as soon as the old oil had all worked out of the boxes, the length of train hauled dropped from nineteen cars to fourteen, and the cost of oil and waste had risen above the figure paid to the contractor.

Here was a case of a direct loss to the company of over 26 per cent. in the hauling power of their locomotives, due entirely to a difference in the grade of oil used. The reader will readily understand that this will compensate for a vastly greater difference in price. In each case the engine was doing all the work of which it was capable, therefore the consumption of coal remained the same. Wages of engineer, firemen and trainmen were the same. Hence the company lost 26 per cent. in crew wages, and the increased cost of oil, but the purchasing agent had the satisfaction of knowing that he was paying the bottom price for supplies. It can hardly be asked whether it paid the company to disregard such a purely theoretical matter as the coefficient of friction of the oil it was using.

A daily second-class sleeping car service has been established on the Atchison, Topeka & Santa Fe, between Chicago, San Diego and Los Angeles, Cal., without change. These cars are similar in all respects to the regular Pullman cars, except that the fittings are not so luxurious and the ornamentation not so lavish. Instead of cushioned seats, slats are used with an elastic spring, and are said to be very comfortable. The other make up of the berths are like the regular cars. The services of a conductor and porter are also maintained. The charge for a night's rest by this system is reduced to 50 cents per night, or $4 from Chicago to San Diego, against $14.50 first-class. At present the new cars are run through to Los Angeles, and the same facilities will be established to Denver. The Pullman Company is building these second-class sleepers as fast as possible, and the Santa Fe road will soon be fully equipped with them. A service of this character is highly desirable, and will be of great benefit to parties who must travel long distances, and yet are unable to pay the high prices of ordinary Pullman cars. But it seems curious that the railroad company cannot run this system of sleeping cars themselves, and thereby reap the financial benefits, instead of turning over the profit to a middleman concern. Of late years we have constantly been hearing about the necessity for improving the service rendered by members of the mechanical departments of railroads, but the traffic departments do little but call for the work to be done cheaper. It seems to us that an agitation to stimulate the traffic departments to make their employés do more for the salaries they receive would not be out of place. Brakemen on passenger trains are no more required to do braking, and it requires no end of energy to get them to attend the stoves properly. There is no reason why they should not be called upon to look after the comfort of travelers, and a good place to train them is to compel them to attend to and keep in some sort of order the cars occupied by second-class passengers. The railroad manager that turns over the revenue of second-class sleeping cars to the Pullman Company has small reason to boast of the transaction.

A very painful train disaster happened last month at Lorenzo, Ill., a station on the Chicago, Santa Fe & California. As passenger train No. 2 Eastbound was leaving the station named, it was run into by a stock train which had been passed some stations back, and the collision was so violent that a private car, which was last in the passenger train, was badly smashed, and six persons were killed. The engineer of the locomotive causing the collision tried to excuse himself by saying that the morning was so foggy that he could not tell what speed he was running at, or that he was so near the station. If this was true, he was a very incompetent engineer indeed, and was not fit to be in charge of a locomotive, but the excuses were evidently the best that could be devised on short notice, and were intended to screen the real cause of the smash up, which was reckless running. The fact that there was a dense fog obscuring the track and land marks aggravated the offense of running into the tail end of a train that was on time. An engineer who has any right to hold such a position of trust and responsibility takes special precautions during foggy weather, because there is difficulty in seeing flagmen at such a time, but this man must have rushed along faster than the passenger train with no more heed to dangerous conditions than if there was not another train upon the division. What made the collision doubly inexcusable was that the stock train was equipped with the air brake, but no perfection of appliances is sufficient to save disasters at the hands of reckless incompetence.

The Chicago, Burlington & Quincy have formed a school of instruction for engineers and firemen and put it in charge of Mr. George H. Baker, a very intelligent and highly skillful locomotive engineer. While on the Wabash Railway, Mr. Baker made a surprising record for the economical working of the engines he ran, and it is intended that the enginemen on the "Q" system shall be instructed in the methods by which Mr. Baker succeeded in saving fuel. The dynamometer car belonging to the company is turned temporarily into a school car, and Mr. Baker is sojourning at the various division points giving the men talks about the best methods of handling locomotives and firing them. This will be followed by instruction on the engines at work. The new enginemen are using a great deal more fuel in doing the work of hauling trains than what was required by the old men, and it is expected that the instruction of Mr. Baker and of other traveling engineers will effect a material improvement in this respect.

Just as most people had made up their minds that the boom in railroad building had passed, and that we were entering upon a period when little or no addition would be made to the railroad mileage of the country for a few years, the *Railway Age* comes out with the surprising information that a greater amount of railroad construction is projected for the coming season than anything that has been known in the country's history, with two or three exceptions. Figures are given to show that the *Age* is prepared to prove the assertion which causes so much surprise. Statistics have been collected by our contemporary, which is the best authority on railroad projects, that show the projected railroad extensions for this year to be 53,436 miles. An encouraging feature about the matter is, that few of the projected lines are intended to parallel existing railroads, most of them being extensions into territory that has not been supplied with railroad facilities. It will be a great and prosperous year if one quarter of the lines projected get beyond the paper age.

Mr. C. P. Huntington appears to watch very closely the details of the vast railroad interests which he controls. In the course of a recent interview with a newspaper man he is reported to have said: "The overland service is now in excellent shape. Back in 1884–85 Stanford and some of my associates forgot that wise saying: 'There is a withholding that leads to poverty,' and the main way was allowed to run down. I wanted them to order 100 new engines and keep the equipment up, but I gave way and let them do as they pleased. The result was that in 1887, when we wanted engines and cars, we could not get them, and prices ran up $3,000 more apiece than in ordinary times. Since then we have been adding to our stock as rapidly as possible. Just before leaving home for this trip I placed orders for 139 more engines for use on various roads. Now our main way is in good order."

At the last meeting of the Western Railway Club there was considerable discussion on a question presented by Mr. F. D. Adams, of the Boston and Albany, viz.: How large a piece must be broken out of the flange of a wheel to change the term "chipped" to "broken?" We think that more attention has been given to the question than its importance warrants. It is obvious that a wheel chipped beyond the limit at which it may be accepted under the terms of the Rules of Interchange is for all practical purposes a broken wheel, no matter under what name the defect may be denominated. The rules of interchange give no directions for making out bills for wheels removed on account of being "chipped," so the inference is that that defect should be charged for as "broken," which it really is.

Judge Gresham has delivered an opinion, Judge Blodgett concurring, in the case of the Pullman Palace Car Company against the Wagner Palace Car Company, in the United States Circuit Court, at Chicago, declaring the Pullman-Sessions patent for vestibuled cars valid, and that the Wagner Company was infringing it. The Sessions patent covers the iron face plates under spring pressure The Court made the temporary injunction against the Wagner Company perpetual, and referred the matter of damages to a Master in Chancery to take testimony. This decision will not prevent the Wagner Company from using vestibule cars. It only prevents them from using friction plates to prevent oscillation, and many better devices than friction plates can be devised for that purpose.

The letter in another column from Mr. Rickard about railroad matters in Chili will be read with interest by our readers. Think of having to pay 1½ cents a gallon for the water used by locomotives, and $7 a ton for coal. Considering these prices it must be bad policy of the railroads to use the scrap heaps of locomotives, which appear to be common, for the useless waste of fuel and water must be very great.

Mr. Rickard is an Iowa man, and got the first of his railroad training on the Burlington, Cedar Rapids & Northern. His father has been employed in the car shops of that road for many years.

The article in another column by Mr. John R. Whitney, of Philadelphia, on the "Behavior of Iron in Solidifying," describes scientific experiments of great value, and the information derived from the tests ought to be made generally known. Nearly all the text books on natural science teach that water is the only substance which expends in solidifying; but Mr. Whitney's experiments prove conclusively that iron acts in precisely the same way, and it is highly probable that all liquids follow the same law with the same result.

At a recent meeting of the Western Railway Club Mr. G. W. Rhodes said: "This discussion has brought out one interesting point, and that is that in making a thing strong, we may make it too strong. We have known where the draught rigging was made too strong. It came up recently on the C., B. & Q. road in the matter of crank pins. At first they broke, and we increased the size of the crank pins and got good results from them for some time; until recently there have been several cases of broken crank pins. They were sent to the laboratory, where they examined them and found them to be all correct and according to specifications, and yet they broke. One of our master mechanics had these pins break as well, and without going into the matter very carefully, he just said he would make them big enough so they wouldn't break, and he increased the hub to 5½ and the diameter of the crank pin to 4¼. I saw him the other day and he said he had had enough of that kind of a thing. He got broken wheels now and he was going back to 4-inch crank pins. There are times when something has to give way.

The letter in another column on The Car Coupler Question, signed New England, is the production of a prominent Eastern master car-builder, and presents a striking view of the question discussed, as seen by one who is in a position to exercise considerable influence on future action about couplers. There are several of the statements made which we do not indorse, and most car-builders are likely to differ from the views expressed, but the letter is well worthy of careful perusal, and as such we commend it to the attention of our readers.

A movement was started to hold a union meeting of all the railroad clubs at Buffalo before the time for the meeting of the conventions for the purpose of settling what changes were desirable on the rules of interchange of cars but the thing has been abandoned through want of time to canvass it properly.

Two more of the men who entered into a plot during the Burlington strike to destroy property with dynamite have been convicted by a jury in Geneva, Ill. One of the men is required to pay a fine of $500 and the other is sent to the penitentiary for one year.

Last week the schooner T. W. Dunn left Philadelphia loaded with ten locomotives, built at the Baldwin Locomotive Works, for the Provincial Railways of Buenos Ayres. These locomotivs are 5 feet 6 inch gauge, and six of them are of the Mogul type, with cylinders 18 × 24, for freight services, and four of them are of the American type, with cylinders 17 × 24, for passenger service. The latter have driving wheels 6 feet in diameter, and the tenders are fitted with water scoops. The Harlan & Hollingsworth Co., of Wilmington, Del., is filling a large order for passenger equipment for the same line.

Personal.

Friends of Mr. J. B. Safford will be sorry to learn that he is mourning the death of his only child, a bright girl.

Mr. J. D. Campbell, superintendent of the New York Elevated, lost three boys within ten days of diphtheria.

Mr. E. P. Lord has been appointed assistant superintendent of motive power of the Pennsylvania Company, with headquarters at Ft. Wayne, Ind.

There is talk to the effect that Mr. J. D. Odell, late of the Chesapeake & Ohio, is about to become one of the chief officers of the Baltimore & Ohio.

Mr. J. H. Setchel, President of the American Railway Master Mechanics' Association, has resigned his position with the Martin Car Heater Company and accepted that of traveling agent of the Pittsburgh Locomotive Works, beginning May 1. These works are enlarging their capacity and preparing for a vigorous campaign in every way.

Mr. H. M. Perry, for some time past the superintendent of the Pullman Car Works, at Chicago, has resigned the position, to take effect April 15. Mr. Perry goes to Knoxville, Tenn., to assume the management of the Southern Car Works. It is surprising the number of men that are around who have at one time been superintendent of the Pullman Works.

Mr. E. P. Vining, traffic manager of the New York & New England, is editing a fine edition of Shakespeare's works. Mr. Vining is a profound scholar and accomplished writer, and few Americans are so well informed on English literature. He thinks that the position taken by Ignatius Donnelly as a Shakespearean critic is on a par with the position taken by the same man as a critic of railroad companies—it is all the result of an abnormal iconoclastic spirit.

Mr. James E. Childs, who has made such a striking success as general manager of the New York, Ontario & Western, has resigned to accept the position of assistant general manager of the Lake Shore & Michigan Southern. Mr. Childs rose through the engineering department, and he is a decidedly broad gauge railroad man with excellent executive ability. We have no doubt that he will make as enviable a record in the wider field of the great Lake Shore as he made on the Ontario & Western.

Terms of Secretary Forney's Resignation.

The following is a copy of the letter in which Mr. M. N. Forney made his resignation as Secretary of the Master Car-Builders' Association:

NEW YORK, March 14, 1889.

To the Members of the Executive Committee of the Master Car-Builders' Association:

GENTLEMEN: As other interests demand all of my time and attention, I have decided that I will not accept a reappointment as Secretary of the Master Car-Builders' Association should it be tendered to me after the next annual convention. As the business of last year has all been completed, and little or none of that for the current year has yet been begun, it seems to be desirable if a new incumbent of the office is appointed, that he should assume its duties before, rather than after, the convention, so that he will become familiar with the business which will be transacted during the meeting, which must be embodied in the annual report for the current year.

For these reasons, I hereby request the Executive Committee to relieve me of the office and duties of Secretary of the Association, at as early a date as it may be possible to agree upon my successor.

In relinquishing my official relations to the Association, I feel sure that it will be a pleasure to me hereafter to remember the acquaintances and friendships which have been made during the time that I have occupied the position of Secretary; and to recall the period and the experience of my term of office. Trusting that the pleasant personal relations of the past will be continued, and that the prosperity and usefulness of the Association may increase in the future, as it has in the years that are left behind us, I am, yours very respectfully, (Signed) M. N. FORNEY.

Another special type of locomotive has gone to join the ranks of many novelties that have come in with flourish of trumpets and disappeared like the silent Arab. Five years ago the prevailing novelty in locomotive design was the Coventry locomotive, which had a return tubular boiler and was conspicuous by having the smokestack behind. The engine ran for some time on the Chicago, Rock Island & Pacific, but her performances did not compare well with that of ordinary locomotives doing the same work. After a somewhat checkered career the engine is now in the shops of the Louisville, New Albany & Chicago being converted into an engine of the ordinary type.

Cincinnati, Sandusky & Cleveland Shops.

The shops of the Cincinnati, Sandusky & Cleveland R. R., at Sundusky, Ohio, are quite busy, having five engines in for overhauling. In the car department a new passenger coach is being built, and four coaches are being repainted. Jos. S. Porter, the master mechanic, has been with the company some 30 years, having learned the trade in the shops he now has charge of.

Mr. Porter uses the extension front exclusively, but has not as yet tried the brick arch on account of hard water. He states that he has to remove flues every ten to twelve months, but never removes crown bars. When the flues are replaced they are painted with a thick coat of asphaltum or stack paint. The crown sheet is also painted. Previous to removing the flues, two or three bushels of shavings are burned in the fire-box close to the crown sheet, the boiler being empty of water. The sheet is then tapped with a hammer, which *entirely* loosens all scale, and so effectually that it is then entirely washed off through plugs in the boiler head. The flues are tapped on the ends with a hammer, and also by aid of a bar introduced into each flue.

The scale drops off, leaving the flues absolutely clean, as is shown by the fact that each flue is removed through its own hole in place of through the dry pipe hole in flue sheet. Scale thus removed is very hard, and from $\frac{3}{8}$ to $\frac{1}{2}$ inch thick.

Mr. Porter has experimented for some time with dyes for passenger car seats, and has succeeded in producing red, blue, green, etc. Most blue and green dyes are not "fast" when applied to plush, but rub off in time. Those invented by Mr. Porter, however, are perfect in this respect, and are so effective that neighboring roads purchase them.

Mr. Porter uses malleable castings on car work as exclusively as he can, finding considerable economy by so doing. He also runs the draft timbers of freight cars to the center of the car where they are joined by a splice joint. Since adopting this plan he states he has had no broken draft timbers.

It Provokes Discussion.

A young engineer on a railroad in Pennsylvania who confesses to being ambitious to rise in the world writes us that the company has supplied the enginemen on the road where he is at work with our pamphlet on "combustion," and that it has excited considerable discussion and controversy among the practical men who have read it. He differs from the teaching of the pamphlet on firing and expresses the belief that an engine fired heavy will steam better and burn less coal than one that is fired light. As we are not familiar with the design and condition of the locomotives on the road where our correspondent runs, we are not able to controvert the correctness of his conclusion, and the pamphlet mentions that under certain circumstances locomotives will steam better with heavy than with light firing. But we do not think that locomotives which need heavy firing are in a satisfactory condition.

The point about the letter, however, that is gratifying is the assurance that the pamphlet has provoked discussion. When it has done that the treatise on "combustion" has performed a highly important purpose. When enginemen get earnestly discussing the best methods of doing their work they are on the direct road to improvement. No book can ever be written that will unaided make men good firemen or good engineers, but if the leading sound principles of the business are laid down, and the men concerned get watching their practice to see how near it can be made to agree with theory they are certain to make themselves as good men as are to be found in the calling.

The Schenectady Locomotive Works are running with a full force, and turned out during the month of March 24 locomotives, as follows: Nineteen 18×26 inch, eight-wheel, for the Union Pacific; three 18×24 inch passenger and one 17×24 inch six-wheel switching for the Cleveland, Columbus, Cincinnati & Indianapolis; one 9×16 inch inspection locomotive for the Delaware & Hudson Canal Co.

General Time Convention.

A meeting of the General Time Convention, which is composed of railroad general managers and superintendents, was held in New York, on March 8. President H. S. Haines, general manager of the Savannah, Florida & Western, occupied the chair. The subjects that engaged the attention of the meeting were: Report of Committee on Train Rules, and Report of Committee on Car Mileage and Per Diem Rates. The committee having the latter subject in charge made up an exhaustive exhibit of the detentions that freight cars are subject to. They also ascertained the views of the different railroad companies on their preference as to how charges should be made for the use of cars, and found that the majority of car owners preferred the per diem basis of payment. The following resolutions were adopted:

Resolved, That the compensation for the use of eight-wheel cars be fixed at $\frac{1}{2}$ cent per mile and 10 cents per day; four-wheel cars one-half of these amounts, and that a general agreement be made to retain these rates for a period of one year, in order that a test of its working may be made at all seasons.

Resolved, That these rates shall take effect upon the respective roads on Jan. 1, 1890.

The benefits that had accrued to the railroad companies interested from the operation of the Car Service Association at Chicago and the Omaha Demurrage Bureau were dilated on in the report. Figures were given which showed that a marked improvement in the handling of cars began as soon as the new rules became effective. For example, the Chicago & Alton, Chicago & Grand Trunk and Chicago, Santa Fe & California formerly averaged six, seven and eight days before recovering the use of their cars, while the Chicago & Eastern Illinois actually averaged 12, 14 and even 15 days' detention, whereas neither of the roads has, since the rules of this association became fairly operative, averaged as high as three days' detention, a saving which would have seemed almost incredible had it been predicted one year ago. Financial results show that the car service collections have gradually decreased, which further indicates that cars are now handled more promptly by shippers and receivers.

Railroad Superintendents' Meeting.

A meeting of the North American Railroad Superintendents' Association was held in New York, April 8, about 30 members being present. President C. S. Gadsden, Charleston & Savannah, occupied the chair. Forty-six new members were elected. Committees were appointed on "Roadway," "Machinery" and on "Transportation." A report on "Machinery" was submitted consisting of a mass of information sent in in reply to an exhaustive circular calling for facts about car heating. A letter was read from Mr. E. R. Tratman on the "Improvement of Track." There was some discussion concerning the use of two short blasts of the whistle as an answer to a signal given by another train or a flagman, the experience of some members being that this signal having been so long and widely used to indicate "let off brakes," it is from force of habit misinterpreted by brakmeen and causes trouble. A heavy freight train entering a yard on a down grade needs to be held very carefully, and if at a critical moment the engineer acknowledges some signal and the brakemen let off the brakes the speed may elude control sufficiently to cause a collision or derailment.

President Gadsden read a paper on "Discipline." He dwelt on the necessity for establishing rules for the government of employés and the difficulties of enforcing them strictly. He quoted what he considered a good code of rules, and mentioned that the penalties for disobedience of them were: first, fines; second, suspension from duty without pay; third, dismissal from the service. He had elaborated the fine system greatly. Considerable discussion followed the reading of this paper.

Since our illustration and description of the Stearn's Flexible Car Axle Box in the March number of the CAR BUILDER orders have been received by the American Railway Equipment Company for the boxes from the Cairo, Vincennes & Chicago, Annapolis, Washington & Baltimore, Cincinnati, Hamilton & Dayton, Nevada County, California, Connecticut River, and other railroads, and are being filled as rapidly as possible.

Mr. H. A. Luttgens, of Paterson, N. J., patentee of the well-known variable exhaust damper, has lately received a great many letters from parties using it, commending the device and testifying to its utility as a preventative of fire raising and as an aid in fuel saving. Our readers will remember that the Luttgens Variable Exhaust Damper is a device set in the base of a locomotive smoke stack with openings for the admission of air, which has the effect of softening the pull of the exhaust. There are eight engines on the Kansas City, Memphis & Birmingham that have got the damper on, and Mr. R. H. Briggs, master mechanic, writes about them as follows: "I consider it one of our most valuable appliances as a protection against fire. With it we can pull cotton with the certainty of not throwing fire from the stack. It further prevents the necessity for opening the furnace door to cool down, thus in a measure adding to the life of flues and fire box."

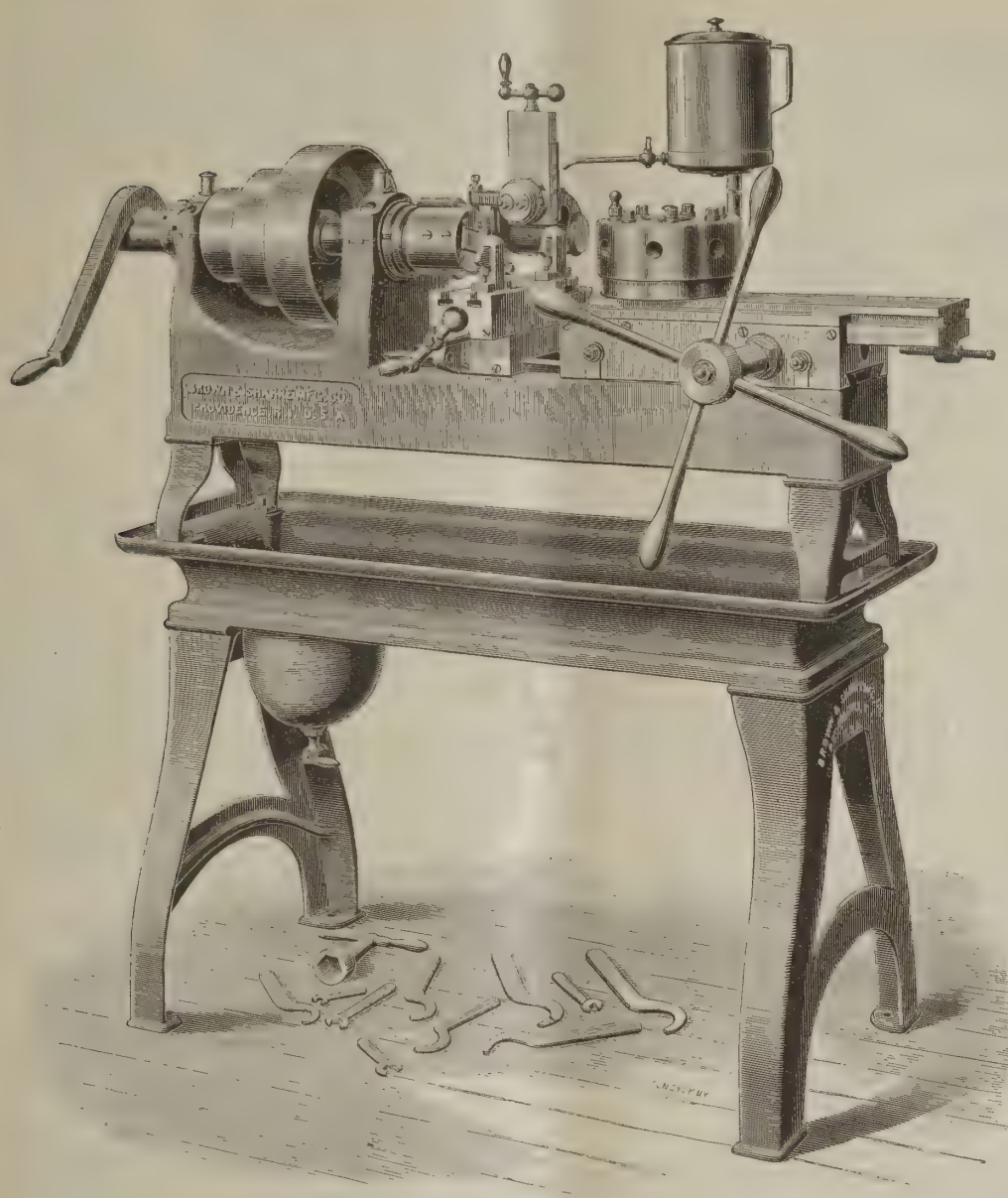
The Sherwin-Williams Company, of Cleveland, have published a very handsome catalogue of standard railway paints and colors. Specimens of all the colors used in different departments of railroad work are given, and each color has a number, so that any one wishing to order a particular shade can do so without risk of mistake. The plan of arranging the actual colors so that customers may have a great variety to choose from will be a great convenience. In the rolling stock department of the book selections of colors are presented for passenger coaches, baggage, mail and express cars, trucks and platforms, walls and ceilings of baggage, mail and express cars, refrigerator and line cars, cabooses, freight cars, locomotives, car roof and floors. This will give rolling stock men an idea of the scope of the work as it applies to their needs. It also gives very full collections of colors for the structure and roadway department. In addition to these there is an interesting "Skeleton History of Pigments," examples of lettering and a great deal of information valuable to the users of paints.

Tobin bronze is the name of an alloy which is being put on the market by the Ansonia Brass and Copper Company, 19, 21 Cliff street, New York, and 133, 135 Wabash avenue, Chicago. The peculiarities of this metal are high elastic limit, great strength, toughness and uniform texture.

It can, when heated, be forged and stamped as readily as steel; it is dropped forged for parts of machinery subject to corrosion, and where greater strength than that of brass or bronze castings is desirable; in fact, its great strength makes its use desirable in hundreds of instances where corrosion is feared; as for example for pump and piston rods, condenser plates, glands, bolts and nuts, propellers and propeller shafts for yachts and launches, etc.

It is also said to make very superior springs either from wire or rolled plates. It works well in the lathe, and finishes a bright gold color. Its specific gravity is less than that of copper, which is of considerable importance when used for ship sheathing and fastenings, and in fact for any purposes about ships and boats.

Tests made by scientific experts show that the alloy is remarkably strong and is not liable to be affected by corrosive influences.



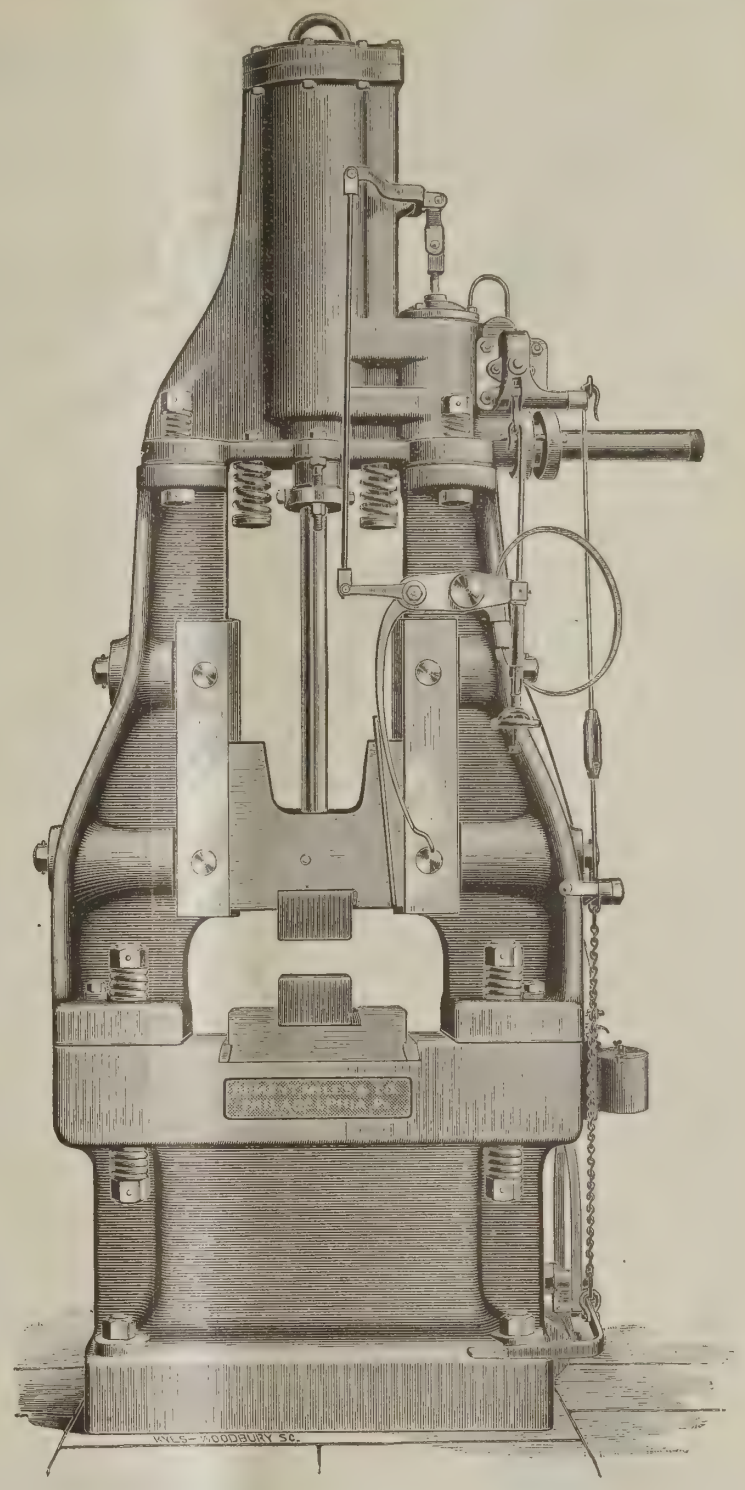
BROWN & SHARPE No. 5 SCREW MACHINE.

The machine illustrated is suitable for making all kinds of screws and studs ordinarily used in a machine shop, also for finishing from the rough bar, or from forgings or castings, many small pieces or parts of machines. Ten tools can be used while the work is held by the chuck in one position, and thus uniformity and accuracy are insured and a saving of time is effected. The cost of the work is correspondingly reduced, and frequently is only 50 to 75 per cent. of that of the same work in an engine lathe.

A lever, to be used in operating the cutting-off slide in place of the screw shown in cut, is furnished when desired. The turret head is secured in position by a simple and durable device.

The spindle boxes, 2¾ inches and 2¼ inches in diameter and 3⅞ inches and 2⅞ inches long, are steel, hardened and ground inside and out. The spindle is also steel; its front bearing is hardened and both bearings are ground.

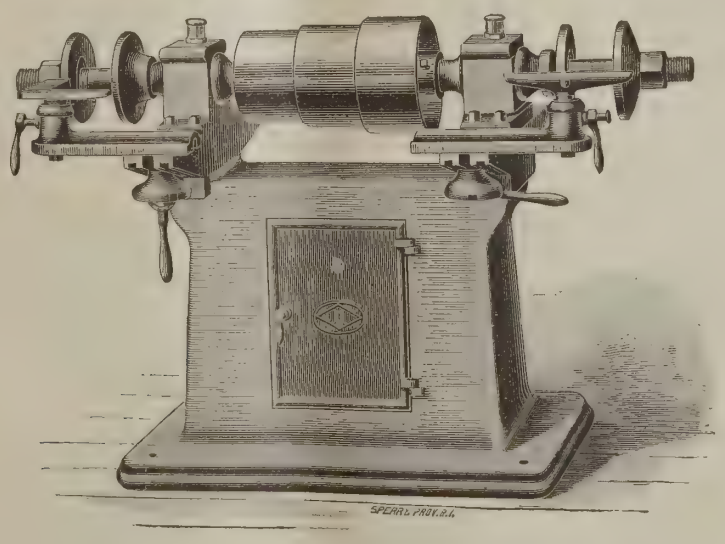
The spindle cone has three grades, 6 inches, 8½ inches and 11 inches diameter, for 3-inch belt. Size of hole through spindle, $\frac{9}{32}$ inches; number of holes in revolving head, 7; diameter of holes in revolving head, $1\frac{1}{16}$ inches; movement of revolving head slide, 9⅝ inches; length that can be milled, 6 inches; swing over slide rest, 6¼ inches; swing over bed, 13⅜ inches; length of bed, 50 inches. The machine is made by the Brown & Sharpe Manufacturing Company, Providence, R. I.



Steam Drop Hammer.

The engraving represents a steam drop hammer by Bement, Miles & Co., Philadelphia, Pa., designed to cover a wide range of work. It is double acting, and by it can be given not only single or successive dead blows, as by an ordinary power drop, but it can be run automatically or by hand or foot, at any length of stroke striking light or heavy blows as desired, in the same manner as the standard steam hammers made by this firm. This is particu larly valuable where drop or stamp work and forging and finishing are to be done under different parts of the same die. Both hand lever and treadle are provided, no change of any of the connections being necessary to use either one. The normal position of the ram when at rest is at the top of its stroke, leaving all clear below it for changing dies and examining work.

If a single blow is required, a sharp downward movement of the hand lever or treadle will cause the ram to fall, and when the hand lever or treadle is released, the ram will rise to its original position. The automatic motion and length of stroke are also controlled by the same lever, or by the treadle. To prevent the ram from rising too rapidly, and striking an upward blow, the throttle and main valve are so connected that when the ram rises the throttle almost closes, allowing to pass only the small amount of steam necessary to hold the ram suspended. This feature, essential to the successful operation of a steam drop, and other important details of construction, are well worked out in this machine. As an additional safeguard, spiral steel buffers are used to stop the ram at the top of its stroke, and protect the cylinder and head from a chance blow. To prevent breakage from continued concussion and jar, sufficient elasticity has been introduced at all desirable points. All fastenings are provided with spiral steel springs, and the adjustable guides, which are used to take up the wear of the ram and keep it in correct alignment, have also steel buffers to take the shock of the blow. These hammers are built in a number of sizes, ranging from 400 pounds to 3,500 pounds, the illustration being taken from one with 600 pounds falling weight.



Large Grinding Machine.

We illustrate on this page a new grinding machine just produced by the Diamond Machine Company, Providence, R. I.

It is especially adapted for use in all large foundries and machine shops, and is a very heavy and solid machine, which insures steadiness. The construction throughout is of equal finish to the best make of engine lathe, having many desirable improvements. It has a steel spindle, engine lathe boxes, and arms for rests both back and front. It will run two emery wheels up to 34 inches in diameter, of any thickness up to 5 inches. It has bearings 9 inches long, and the size of spindle in bearings is 2⅛ inches, with 2-inch spindle between flanges. The machine stands 32 inches high from floor to center of spindle, and its weight, complete with countershaft, is 1,050 pounds. The construction of this machine makes it especially desirable for large and heavy grinding

Any further information can be had of the manufacturers, who have a branch house at 51 South Canal street, Chicago, Ill.

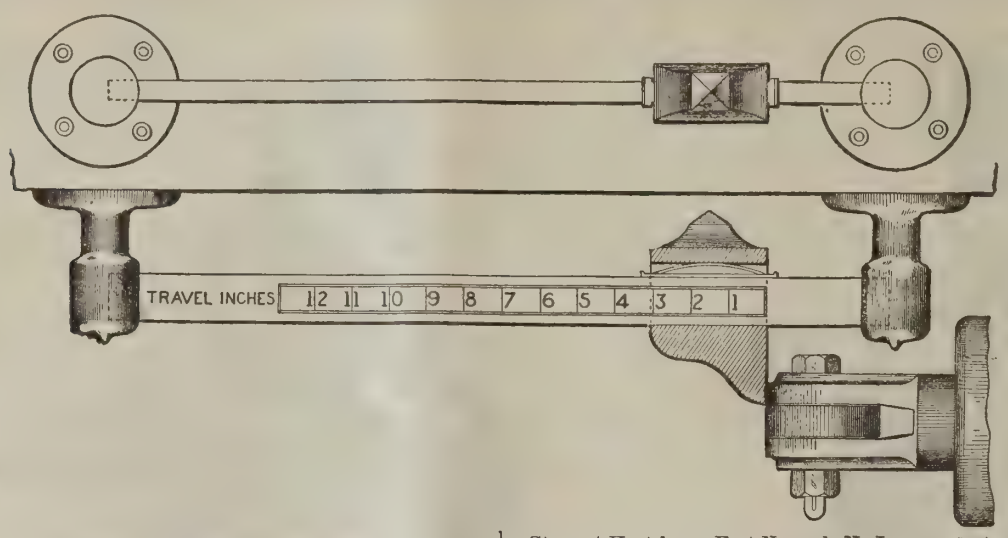
A new use of graphite consists in its application to wire rope. Wire rope is expensive, is rapidly coming into a much larger consumption. It is largely used in distant fields and mines, where breakages cost double and treble the usual expense of repair, so that a wire rope preservative is literally a boon.

This is found in graphite. The graphite must be pure and only the flake is useful. The best is the Ticonderoga graphite flake, mined and prepared for the market by the Jos. Dixon Crucible Company, of Jersey City, N. J.

This Graphite is then prepared by the same firm in a grease which makes the application of the Graphite to the wire rope easy.

The Graphite prevents the wire from rusting—it saves the rope from abrasion when striking hard substances; it also prevents the wires forming the rope from abrasion one against the other as the Graphite finds its way into and fills the minutest spaces, and is held there by the fatty substances in the mixture. The facts above are furnished from his own experience by one of the leading mining engineers of the country.

Messrs. Prosser & Son, New York, representatives in America of the Krupp Steel Works of Germany, have sent to their patrons and friends a paper weight having a fine view of the Krupp Works. The works are of immense size, for they cover an area of 1,200 acres, and about 20,000 men are employed in them. They appear to make nearly all large articles that are made of steel. Among the articles manufactured in the works for railroad use are all kinds of axles, tires, wheels, crank pins, and all sorts of steel forgings.



Automatic Air Brake Register.

The importance of an invention enabling a car inspector to perceive at a glance how far the piston of a brake cylinder is traveling will be recognized by all practical railroad men. Feeling the necessity for having a simple contrivance of that kind, Mr. Robert Potts, foreman of car repairs of the Michigan Central Railroad, invented the device represented in the annexed engraving.

The automatic air brake register consists of a head sliding with some friction along a bar marked in inches indicating the stroke of the air brake piston. This bar is attached to the under side of the car sills, so that when the brake piston is home and the brake completely released, the sliding head or indicator touches the air brake cross-head and at the same time stands at zero on the scale. It is shown in this position on the illustration.

It is evident that when the brake is applied, the cross-head will push the sliding head forward, and that the travel of the latter will correctly indicate the stroke of the piston. When the brake is released the piston and cross-head move back, leaving the indicator head showing the travel. The spring shown in the sliding head prevents it moving with the oscillation of the car, but permits it to move when pushed by the cross-head. The cross-head can thus only move the sliding head forward, therefore the latter always indicates the maximum distance which the piston has traveled.

The general adoption of this register under passenger cars would certainly materially increase the efficiency of brake service, for it is undoubted that the brakes on a large percentage of cars are rendered useless during a portion of each journey by the piston getting to the end of its travel without its condition being noticed. The device costs so little that the prevention of one accident would repay many roads the outlay for their whole passenger equipment. It is manufactured by the Griffin Machine Works, Buffalo, N. Y.

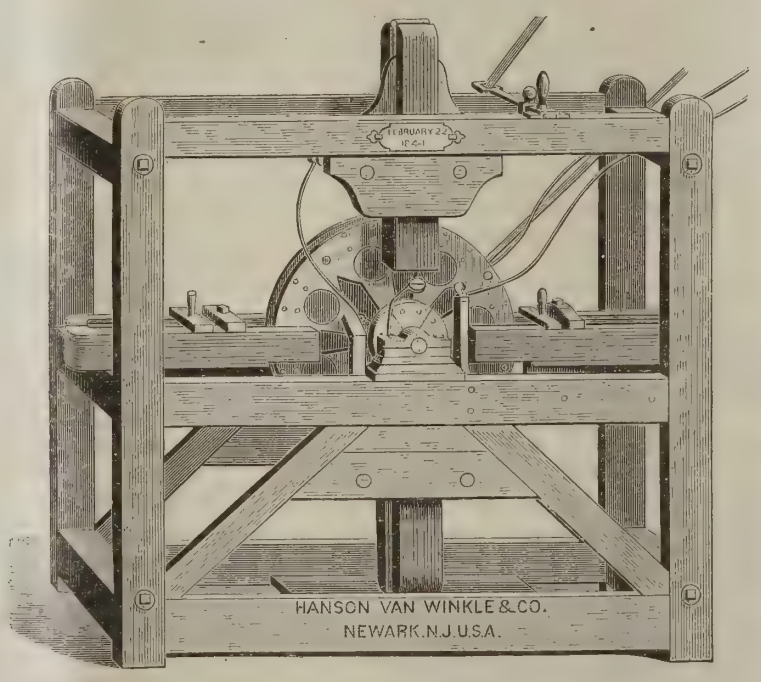
Stewart Hartshorn, East Newark, N. J., manufacturer of window shades and shade fixtures, has got out an illustrated pamphlet giving useful information about how to measure and order for shades. Parties wanting well made and properly fitted window shades ought to send for the pamphlet.

The demand for economical sawing is on the increase. Splitting lumber almost from the log is the latest scheme, and its merit consists of increased production and the saving of time, lumber and expense. You get infinitely better sawed lumber. The Egan Company, of Cincinnati, Ohio, U. S. A., will be glad to give further information to interested parties.

We have received from the Dunham Manufacturing Company, Boston, a very handsome paper weight in the shape of an elaborately finished Servis tie plate. It displays as great tenacity in keeping our papers on the table as the plate is said to exhibit in keeping rails from cutting into ties on the roads where it is in use. We are informed that there is a lively demand for the plate from roads all over this continent.

The Magnolia Anti-Friction Metal is used extensively for the bearings of electric dynamos and other high-speed machines, and gives general satisfaction in this kind of hard service. Professor Robinson, of the Ohio State University, who has made repeated tests of this alloy, writes: The peculiarities of the Magnolia metal were soon noticed as in every way favorable for bearing linings, viz., softness, by which it readily adapts itself to the bearing surface without special care; the ease with which it is cast into a perfect lining, its unctuous or graphite-like feeling, as if possessing lubricating qualities of its own. These peculiarities, in my opinion, give the Magnolia metal very considerable advantages over the others tested for use in journal bearings.





Electro-Plating—The Old and the New.

Messrs. Hanson, Van Winkle & Co., of Newark, N. J., are widely and favorably known for their work in the line of manufacturing electro-plating apparatus. They were the first to undertake this branch of business in this country, and introduced the popular use of nickel plating, and deserve great credit for the vast strides that have been made in this country within the last 15 years in the manufacture of metal goods, in which we now so far excel in quality and price all European manufactures. The possible continuance of the high price of copper for some years is naturally turning the attention of manufacturers to the substitution of low-priced metals for copper and its alloys, consequently the use of iron, steel, spelter, etc., plated with silver, tin, brass, bronze, copper and nickel is rapidly increasing, and as the process must be simple and inexpensive, this company is giving a great deal of attention to this branch of its business. They manufacture all the chemicals entering into the various solutions, lacquer, etc., and can guarantee successful results.

The great invention of depositing metals by means of a permanent current of electricity obtained from steel magnets—an invention founded upon the great discovery of Faraday—was perfected and first successfully worked by Messrs. Prime & Son at their large silverware works, Birmingham, England, and the original machine, constructed by Woolrych in 1844—the first magnetic machine that ever deposited silver on a practical scale—is still preserved at their works in its original position, as a valuable and interesting relic. An illustration of this old machine is given with one of the "Little Wonder" machines, showing the comparative sizes very accurately. Prof. Faraday paid a visit, with some of his London friends, to Messrs. Prime & Son's works purposely to see this application of his discovery in practical operation, and expressed his great delight at witnessing so early and extensive an application so successfully carried into practical use. This machine was worked for many years, until superseded by one of Messrs. Hanson, Van Winkle & Co. It was the forerunner of all the magnificent dynamo machines that are now so extensively used in the arts and sciences of the present day, for electro-depositing metals, electric lights, etc., etc. In looking back it appears strange that the further development of his grand idea should have laid dormant for nearly forty years, and should then be taken up by American skill and brought to its present state of perfection.

The Woolrych machine stands 5 feet high, 5 feet long and 2½ feet wide. The power required by the "Little Wonder" machine is less than one-tenth that of the Woolrych machine, and the amount of metal deposited by the "Little Wonder" is ten times as much in a given time.

In the new and very attractive catalogue just issued, Messrs. Hanson, Van Winkle & Co. present an accurate portrait of the great scientist, Michael Faraday, who died Aug. 25, 1867. This catalogue is a unique and interesting publication, and will be much sought after.

Murphy & Co., varnish makers, announce that they removed their New York office to Newark, N. J., May 1. The firm say in announcing the change:

The removal will add greatly to the convenience and expedition of our business, and we will be glad to see our friends whenever they can make it convenient to come to Newark. The extent and completeness of our plant, which has recently been greatly enlarged, make it interesting to varnish buyers and will, we think, compensate for the hour or two which the journey from New York requires.

Our Directory.

We note the following changes since our last issue. Our readers will do us a great favor by giving us prompt notice of any changes that may come to their knowledge or of any error that may be noticed in our list:

Alleghany Valley.—Henry D. Welsh has been elected president, to succeed the late John Scott.

Atlantic & Pacific.—A. A. Gaddis having resigned, the office of general superintendent has been abolished.

Battle Creek & Bay City.—W. K. Ackerman, receiver, has appointed W. Irving Fox general superintendent, with office in Battle Creek, Mich.

Brooklyn, Bath & West End.—Mr. Boyle has been appointed master mechanic, with office in Brooklyn, N. Y., to succeed N. Dickenson, resigned.

Central Georgia.—Mr. T. L. Chapman has been appointed engineer of rolling stock in place of Mr. Charles Blackwell, resigned.

Central of New Jersey.—G. De Witt Smith has been appointed purchasing agent of this company, succeeding A. Reckless, deceased. His office will be at 119 Liberty street, New York.

Chautauqua Lake.—Jacob P. Crans has been appointed assistant superintendent of the road, with office at Jamestown, N. Y.

Chicago & Ohio River.—J. D. Livingston has been appointed general manager of the company, with headquarters at Kansas, Ill.

Cincinnati, New Orleans & Texas.—Mr. W. W. Wells, superintendent of the Cincinnati Southern Division, died suddenly. April 3, in his car, at Somerset, Ky.

Duluth, Red Wing & Southern.—Mr. J. H. Lakey has been appointed general superintendent.

Elmira, Cortland & Northern.—The office of Albert Allen, general superintendent, has been removed from Elmira to Cortland, N. Y.

International & Great Northern.—E. M. Alvord has been appointed purchasing agent, with office in Palestine, Tex.

Jacksonville, Tampa & Key West.—M. R. Moran, general superintendent, having resigned, J. A. Larnerd, general freight agent, will, until further notice, act as superintendent in addition to his other duties, with headquarters at Jacksonville, Fla. John H. Bland has been appointed Florida purchasing agent, with headquarters at Jacksonville.

Kanawha & Ohio.—L. D. Button has been appointed general superintendent, with office in Charleston, W. Va.

Lake Shore & Michigan Southern.—J. E. Childs has been appointed assistant general manager, with office in Cleveland, O.

Mexican Central.—Edward A. Whorf has been appointed assistant to the general manager, and David Mackenzie has been appointed superintendent of the Tampico Division, with office at Tampico, Mex.

Mexican National.—P. I. Milan has been appointed assistant superintendent of the Matamoras Division, with office at Matamoras, Mexico, to succeed W. W. Mayberry, resigned. Mr. W. J. McCammin has been appointed master mechanic, vice Mr. Winslow resigned.

Mobile & Ohio.—Mr. James C. Clarke has been elected president, and will continue to act in the capacity of general manager as heretofore.

Montana Central.—E. H. Beckler, in addition to his duties as chief engineer, has been appointed superintendent, with headquarters at Helena.

Monterey & Mexican Gulf.—J. A. Robertson has been appointed assistant general manager, with office at Morterey, Mex.

New York, Ontario & Western.—John Burton has been appointed general manager, and John B. Kerr, who has been acting manager, has resumed his duties as general counselor. R. B. Ricard succeeds Mr. Burton as secretary and treasurer, and Charles A. Draper succeeds Mr. Ricard as purchasing agent and paymaster.

Northern Pacific.—Mr. W. McWhite, acting superintendent of the Montana Division, has resigned. Mr. J. D. Finn, superintendent of the Yellowstone Division, succeeds him. Mr. F. H. Marsh, chief train dispatcher of the Yellowstone Division, has been appointed to succeed Mr. Finn.

Oregon Railway & Navigation Company.—C. J. Smith has been appointed general manager, vice W. H. Holcomb, resigned, with headquarters at Portland, Oregon.

Pennsylvania Company.—E. P. Lord has been appointed assistant superintendent of motive power, and will be located at Fort Wayne, Ind.

Peoria, Evansville & Decatur.—C. C. Robinson, general foreman, has been made master mechanic.

St. Louis, Arkansas & Texas.—The offices of division master mechanic in Missouri, Arkansas and Texas have been abolished, E. W. Marshall, Pine Bluff, Ark., general master mechanic, assuming the duties of the positions.

San Francisco & North Pacific.—Mr. H. C. Whiting, general superintendent, has recently been elected general manager of the company.

Southern Pacific.—Mr. J. C. Stubbs has been promoted from the position of general traffic manager to that of general manager.

Texas & Pacific.—J. L. Griffen, superintendent of the Transcontinental Division, and J. Kertin, superintendent of the Eastern Division, having resigned, the divisions have been combined and will be known as the Eastern Division. John Bradley has been appointed superintendent of the Eastern Division, with headquarters at Marshall, Tex.

Zanesville & Ohio River.—E. C. Winstanley, traffic manager, has been appointed general manager. The latter office has heretofore been filled by the president.

Employment.

WANTED.—One or two good draughtsmen for locomotive work. Apply to "Chief Draughtsman," care NATIONAL CAR AND LOCOMOTIVE BUILDER.

NATIONAL CAR AND LOCOMOTIVE BUILDER

JUNE, 1889.

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The Florida Central & Peninsular Railroad Co. will soon commence work on their machine shops at Fernandina, Fla.

At Grafton, W. Va., the Baltimore & Ohio Railroad Co. are erecting car and repair shops, where they will employ 200 men.

W. B. Snead & Co. have contracted to build new machine shops at Lynchburg, Va., for the Lynchburg & Durham Railroad Co.

Thirty-six car-loads of pipe are being turned out every twenty-four hours at the National Tube Works Company, at McKeesport, Pa.

Owing to the prevailing dullness of business the work on the new shops under construction for the Union Pacific at Cheyenne, Wy. T., will not be pushed much this season. No part of the establishment will be completed except the machine shop and the blacksmith shop.

The Stemton Car Works, at Stemton, lately shipped a number of new cars to the island of Cuba, for use in transporting iron ore from the mines of the Jaragua Iron Company to the seashore. The works have enough orders on hand to keep them in operation until next July.

The decapod locomotives, designed by Mr. George W. Cushing for pulling trains over the Cascade Mountains before the tunnel was finished, worked continually for two years on the heaviest grades ever operated by smooth-wheeled locomotives without a single failure or accident.

The Litchfield Car and Machine Co. is building for the Belleville & Southern Illinois (Cairo Short Line) 150 fruit, 50 refrigerator and 50 box cars. The 18 passenger coaches for the Union Pacific recently offered to the St. Charles Car Co. have been let to the Litchfield Car and Machine Co.

The Lake Shore & Michigan Southern shops have been busy for the past month in fitting vestibule cars with clamps for fastening the cars together at the top, this device being used in place of the springs which have been taken off in consequence of the decision in the patent suit of the Pullman against the Wagner Company.

The Baldwin Locomotive Works, of Philadelphia, will in a short time turn out locomotive No. 10,000. This will be built for the Northern Pacific, and will be a consolidation similar to those furnished this company last year. It is the intention of the builders to make this the finest and best equipped locomotive that has ever been built.

The Baltimore & Ohio Railroad Company has finally decided to abandon all construction work at its Mount Clare Works. The long period of financial embarrassment of the railroad has compelled it to abstain from putting in any new and improved machinery, and the rolling stock can be purchased cheaper than it can be made at the Mount Clare Works.

J A. Fay & Co., Cincinnati, are said to have the finest exhibit of wood working machinery in the Paris Exposition. They have 27 machines in a group driven by an independent engine, connection being made by means of underground shafting. All the machinery is shown doing work, and the processes performed attract great attention from visitors.

The tunnel two miles long on the Northern Pacific that goes under the range of the Cascade Mountains is lighted up throughout its whole length with electric lights placed about 100 feet apart. The electricity is generated by dynamos driven by turbines receiving motion from the streams of water that constantly flow from the melting snows on the mountain range.

A test of the Widdifield & Bowman electric car brake was made lately on the Lehigh Valley Railroad, with a train or 14 empty box cars. A run of eleven miles and return was made and the brake was subjected to various stopping tests at speeds and on grades varying from 7 to 40 feet per mile. The brake worked satisfactorily in every instance, and the stops made were remarkable for their smoothness.

The Chicago *Herald* says that nearly 1,500 men at Pullman are idle, and those that work at all work short time. Freight shops are closed entirely, as railroads are not placing orders for equipment. The Michigan Car Company and Peninsular Car Company are underbidding Pullman right along. A recent order for 500 cars was taken away from Pullman by an Eastern firm, which bid $35 under Pullman.

The New York, New Haven & Hartford are getting some new heavy passenger locomotives built at the Rhode Island Locomotive Works. The engines are eight-wheelers and have cylinders 18 × 24 inches, and driving wheel centers 60 inches diameter. The boiler is of the wagon top kind, 52 inches diameter at the smallest ring, and the shell is made of steel ⅝ inch thick, the heaviest material we have ever known to be put in the boiler of a locomotive.

The railroad from Mollendo to Arequipa is remarkable for running nearer the stars than almost any other railway, for where it passes over the western range of the Andes into the great basin of the southern continent the track is 14,765 feet above the sea, and the only higher point at which a wheel was ever turned by steam is where another Peruvian railway tunnels the Andes. No other long road can show an equal amount of excavation nor such massive embankments, and the engineering difficulties overcome in its construction were enormous.

We have received from the United States Rolling Stock Company an interesting record of tests of car axles made by the forge department of the works at Anniston, Ala. The axles were for cars under construction for the Savannah, Florida & Western. They were iron of the M. C. B. standard size, and were required to stand without sustaining damage three blows of a 1,640 pound weight dropped 10 feet, and two blows of the same weight dropped 15 feet. Five axles promiscuously selected each stood three blows from the weight descending 10 feet and five blows of the weight falling 15 feet without any of the axles being injured.

The Fox Solid Pressed Steel Co., of Chicago, Ill., of which our contributor Mr. W. Voss is assistant engineer, are preparing to put upon the market steel cars and trucks made by special processes under heavy hydraulic machinery designed for the purpose. The company recently submitted to a meeting of railroad men various designs of steel cars and trucks, the object being to show railroad people what has and can be done with steel as a material for building cars. Steel cars are very largely used on Indian railways, and Mr. Hughes, chief engineer of the company, has had long experience as a railway mechanical superintendent in India, so he was able to explain the working of steel cars in actual service.

Just as we are about to go to press, we have received from Mr. A. Mallet, Paris, the celebrated French mechanical engineer and inventor of the first successful compound locomotive, two letters commenting on the paper on Compound Locomotives, by Angus Sinclair, that appeared in last issue of the NATIONAL CAR AND LOCOMOTIVE BUILDER. Mr. Mallet does not consider the paper does him justice in saying that Nicholson designed a comqound locomotive that was capable of being made an engineering success, and he explains the leading defects of the engine. He also informs us that his compounds are so constructed that they may be worked simple or compound, at the will of the engineer. We will gladly publish the letters in our next issue.

A most dastardly crime of train wrecking was perpetrated on the St. Louis & San Francisco railroad, near Sullivan, Mo., on the night of May 23. The fish plates and spikes were removed from several rails on a high embankment and a passenger train ran into the break in the track. A bad wreck followed and a great many passengers and train men were injured, some of them very severely, but strange to say no one was killed outright. The motives of this crime of train wrecking are unknown, but a large reward has been offered for the arrest of the guilty parties, and it is to be hoped that they will meet with the punishment they deserve. Train wrecking ought to be made a capital offense, even where it does not cause the death of intended victims.

There are, we are aware, divergent views as to the use of various terms used in railroad parlance. But some basis of agreement ought to be possible of attainment. All ought to be able to agree that simple words, other things being equal, are preferable to compound words; that ambiguous words shall be replaced by words of specific signification; that words of proper derivation and accredited use shall be preferred to those that are mongrel in origin and marked by provincialism.

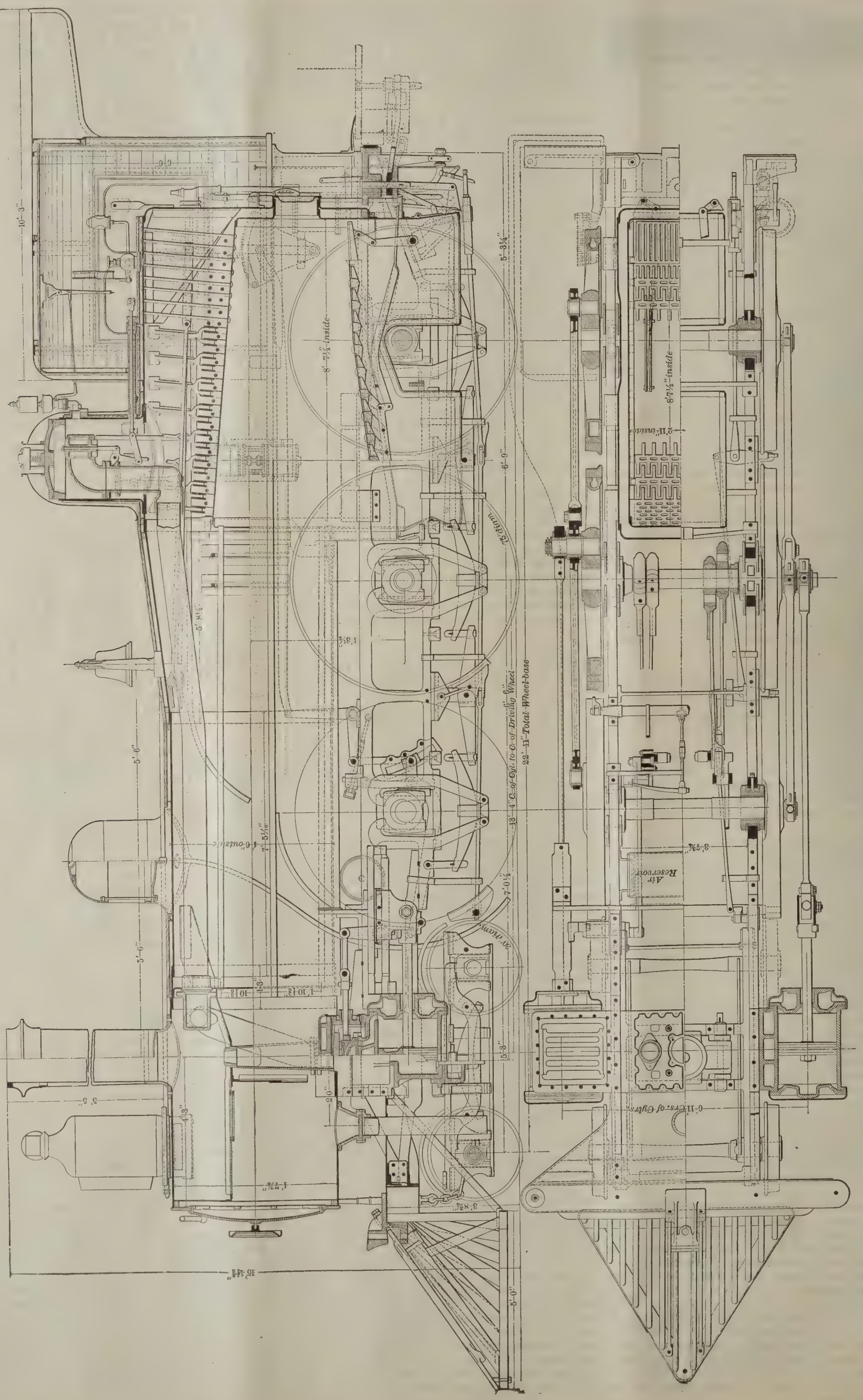
A step in the right direction would be the general use, by railway and other journals, of the abbreviations "Ry." and "Rd." for railway and railroad, and the uniform employment of the words, "Locomotor," "Stoker," and "Station." A movement toward reform in railway nomenclature ought to receive hearty encouragement, and there is no more favorable time than the present for inaugurating it. The subject is of interest on both sides of the Atlantic.—*Railway Register.*

Joshua Rose tells in a Paris letter to a contemporary of an interesting experience of his in a large and important technical institution in France. He entered the place and found flat drills in use, and was told by the students that they could not use twist drills because they "fired." On being asked to show him one that had "fired" the student brought from a tool chest a ¾-inch twist drill that had been ground on a common grindstone, the two cutting edges being at a different angle, and one side being longer than the other, while the high corner was worn completely off. On being asked to try the drill in Mr. Rose's presence, he put it into a machine, ran it at a speed that was not above one-quarter fast enough, and tried to force it to cut until sparks of fire flew out and the drill softened at the end. When Mr. Rose ground up the drill (removing the softened point), and ran it a proper speed, the student was amazed at its work, and said he had "often wondered how the Americans made them work."

The government has awarded the building of the boilers and engines of the warship "Texas" to the Richmond Locomotive Works, that firm having been the lowest bidder. The contract price is $635,500. The boilers are four in number, and will measure 14 feet in diameter. The company undertaking to do this work are as well provided with the necessary facilities as any concern on this continent, but we understand that considerable additions will be made to the boiler-making machinery, and the force of men will be materially increased. Two years and a half is the time allowed for the completion of the contract. Southern people are highly gratified that the Richmond Locomotive Works have got this contract, and a leading Richmond journal asserts that the securing of this contract will mark a new era in the Southern manufacturing progress and development, and recognizes it as showing "that whether the administration be Democratic or Republican the Southern States are to be granted equal privileges in the Union."

The New York, New Haven & Hartford Railroad Company refused to comply with the law of New York State forbidding the use of stoves in passenger cars, and they have been prosecuted by the Attorney General of New York State for violation of the law. The defense set up by the company was that the portion of their road in the State of New York is under 50 miles long, and as the law exempts railways with less mileage than that, they claimed to be exempt also. Judge O'Brien, in the Supreme Court, New York City, issued a decision against the company, holding them liable for penalties aggregating $7,000. In his decision the Judge says: "Being a police regulation which the Legislature had the right to enact, and the same not conflicting with any Federal or State restrictions upon the legislative power in this regard," he is of opinion "that the act is valid, and that it applies to the defendant railroad, which is more than fifty miles in length, although having but twenty-four miles within this State. This seems to me to be the fair, natural and reasonable construction to be given to the acts."

It is thought that steel will soon be as well established in practical use for railway axles as it is now for rails, one important fact tending to this conclusion being the discovery of a toughening process by which the failure heretofore experienced in the use of steel axles are avoidable, the most severe tests under this improved system showing no irregularity or weakness. So satisfactory, indeed, has this method proved, that the supplementary test of fifty blows of 1,640 pounds drop, at twenty-five feet, has been successfully passed by numerous consecutive test axles, and which, being tenfold in excess of the legal requirement, is an abundant guarantee of safety. In this process the axle is heated to the temperature at which its carbon changes to hardening carbon, and then, while it is being rapidly revolved, it is immersed in a water bath, at the same time having thrown upon it a series of submerged jets. After cooling the outside, the axle is removed from the bath while there is sufficient heat remaining in the interior to raise the whole mass to a low red heat and to allow the carbon to change back to the non-hardening state. The principal object in view, in cooling rapidly through a certain range of temperature is to prevent a weak crystal formation.



CANADIAN PACIFIC TEN-WHEEL PASSENGER LOCOMOTIVE.

Ten-Wheeled Engine, Canadian Pacific Railway.

The accompanying illustration, and that on the opposite page, show a ten-wheel engine, designed and built by Mr. F. R. F. Brown, Mechanical Superintendent of the Canadian Pacific Railway, at the shops of the company, Montreal. The engine is intended for working heavy passenger service on the line between Toronto and Montreal, and is equipped with the latest pattern of Westinghouse automatic brake, with floating brake on driving wheels.

The principal features are the high boiler pressure (180 pounds), and the large grate area (26.3 square feet), which is found amply sufficient to maintain the pressure under the heaviest service, and enables a large exhaust nozzle to be used.

The truck is of the ordinary four-wheeled type, and the engine is found to curve with a remarkable degree of steadiness and freedom.

The frames are forged solid from the back end to front of leading drivers, and the front frame is formed by two bars arranged in a manner which is probably a new feature in ten-wheeled engines; these two bars embracing the cylinders are connected to the main frame by spliced and keyed joints. Both these bars are extended to the back of buffer beam, being there keyed and bolted together, the upper bar being checked on top for a heavy cross plate laid on flat. All are rigidly secured to buffer beam by heavy angle irons and brackets, thus forming an efficient protection to the cylinders in case of collision.

The length of frames beyond the cylinders is somewhat less than usual practice, and the angle between the upper and lower bars forms a very strong front end, thus enabling the unsightly diagonal stay to smoke-box to be dispensed with.

The back ends of frames are securely bolted to a heavy cast iron foot-plate, The middle portions of frame are well stayed to prevent twisting.

The fire-box is placed between frames but is long enough to give ample gate area. It is supported by means of expansion brackets studded to fire-box in the usual manner.

The grate is rocked in two sections by separate handles on face plate, and the dump can be worked easily by a handle from the foot-plate.

The ash-pan is constructed in sections, so as to be easily removed without taking down any other part but the dump shaft, thus enabling any repairs to be made without taking the wheels out. Both ash-pan and grate carriers are rigidly connected to foundation ring only, and not to fire-box plates or frame in any way.

The boiler plates are all Siemens-Martin mild steel of fire-box quality, imported from Scotland, with the exception of the connection ring from barrel to smoke-box, which is of Low Moor iron and welded, and the whole are sheared, punched and riveted by Tweddell's hydraulic machinery, with steel rivets and stays of extra mild quality.

The valves are Delancey's patent balanced.

The truck has "Krupp wrought-iron disk" steel-tired wheels, 30 inches diameter.

U. S. metallic packing is used for piston rods and valve stems.

The cross-heads are of mild cast-steel, of the Laird type, and have hard brass blocks, and the side bearings are babbitted.

The slide bars are of forged Siemens-Martin mild steel. The driving axle boxes are of cast-steel, and have brass liners, to prevent cutting driver wheel hubs. The radius links also are of cast-steel.

The engine is capable of exerting a tractive force of 117.3 pounds per pound pressure on piston.

It is equipped with driver brakes of the floating type, which apply on all driving wheels, a separate reservoir being used.

Feed water is supplied by one No. 10 Gresham & Craven combination injector, bolted on face plate on right hand side, this injector containing in itself steam, feed, overflow and check valves, and one No. 10 Gresham & Craven automatic restarting injector on left hand side, with top check on face plate. Sight feed lubricators are used. The cylinders, steam chest and all steam passages are carefully clothed, so as to avoid condensation as far as possible.

The cab is of steel plate No. 10 I. W. G. thick with butt joints and rivets countersunk outside so as to give a perfectly smooth finish, the roof being arched and rounded to front and sides, in keeping with the general design of engine. It is lined with wood, which can easily be removed if necessary, and there is an air space of an inch and a half between the plate and wood, to equalize the temperature inside the cab, and prevent inconvenience from climatic changes.

This is probably the first steel cab of this description and finish that was ever built on the continent of America.

Following is a list of principal dimensions.

CYLINDERS AND MOTION.

Diameter and stroke	20 in. × 22 in.
Distance apart of centers	6 ft. 11 in.
Steam ports—length and width	18 in. × 1.11-16 in.
Exhaust " " "	18 in. × 3⅛ in.
Diameter of piston rod	3¼ in.
Length of connecting rod	9 ft. 4 in.
Journal " " —length and diameter	5 in. × 4½ in.
Travel of valve	6⅛ in.
Throw of eccentrics	5½ in.
Lap of valve	15-16 in.
Lead of valve	7-32 in.



CANADIAN PACIFIC TEN-WHEEL PASSENGER LOCOMOTIVE.

WHEELS AND FRAMES.

Driving wheels, diameter	6 ft. 3 in.
" " tires, thickness	3 in.
" " " main driving and trailing, flanged width	5½ in.
Driving wheels, tires, leading—bald	6 in.
Driving axle journals, diameter and length	7 in. × 8 in.
Truck wheels, diameter	30 in.
" " tires, width and thickness	5 in. × 2½ in.
" axle journals, diameter and length	5 in. × 8 in.
Fixed wheel base	6 ft. 9 in.
Total wheel base of engine	22 ft. 11 in.
Thickness of frames	3¼ in.
Width over frames	4 ft. 2¼ in.
" between tires	4 ft. 5½ in.
Center of cylinder to center of driving axle	13 ft. 4 in.

BOILER.

Length of barrel	12 ft. 6 in.
Drains of smallest course outside	4 ft. 6 in.
Thickness of plates	½ in.
Fire-box shell, sides, thickness	½ in.
" " throat, face and top thickness	9-16 in.
" " inside, crown and back	⅝ in.
" " " sides thickness	5-16 in.
Tube plates, thickness	½ in.
Fire-box, inside length	8 ft. 7½ in.
" " width, bottom and top	2 ft. 11 in. and 3 ft. 9 in.
" outside length	9 ft. 4 in.
" " width, bottom	3 ft. 6⅝ in.
" total depth inside, front and back	5 ft. 1¼ in. and 3 ft. 7 ¾ in.
Number of tubes	204
External diameter	2 in.
Length between tube plates	11.10 1/16 in.
Heating surface—tubes	1,370.6 sq. ft.
" " —fire-box	120.4 sq. ft.
" " —total	1491.0 sq. ft.
Grate area	25.3 sq. ft.
Weight in working order, on truck	23,000 lbs.
" " " " on drivers	84,000 lbs.
" " " " total	107,000 lbs.
Weight of tender, empty	30,000 lbs.
Capacity " coal	10 tons.
" " " water	2,800 Imp. or 3,360 Am. gals.

Tender has 33 inch "Knapp W. I. disk" steel tired wheels.

Studious Firemen.

One of the most hopeful signs of the times for the future economical operating of railroads is the active interest displayed by locomotive firemen in all matters pertaining to the management of the locomotive. The present firemen are the future engineers, and the engineer can do more to waste or save money than any other railroad man. The fireman of the past was satisfied if he could learn how to handle the engine in any way that would enable him to make running time when his turn to sit on the right-hand side came around. The fireman of to-day is striving to find out how he can induce the engine to make running time with the least possible expense for fuel and repairs. This change in sentiment is due, in a great measure, to the sensible stand taken by the conductors of the *Fireman's Magazine* and by other officers of the Fireman's Brotherhood, who boldly inculcate the doctrine that the members ought to give the best possible service in return for good pay. The effect of this is seen in constant discussions in the magazine as to the best methods of firing and the best way of handling the engine to use the least possible volume of steam in doing work. Men who are occupying their minds in this way will give a good account of themselves as engine runners. Meanwhile we would caution these anxious inquirers after knowledge against imagining that they have learned the whole business, because they have taken part in discussing engineering questions. To the young men starting out we would give the following advice from an old engineer that has already been in print:

When a fireman is promoted to the position of engineer, he, as a general thing, wants every person to know that he is running, will try to make faster time than old men, and will be indignant with all his companions on the road. If a brakeman misses a coupling he will get cranky and call him all the names not contained in the dictionary. Now this is not the way to become successful. A better way is to make yourself familiar with the rules and regulations of the company you are working for, become well acquainted with the schedule rights of trains, and understand all telegraph orders before signing them, and then carry them out to the letter. When you arrive at the end of the trip you must always have plenty of water in the boiler; look around your engine carefully, and if you can discover any nuts loose, you should tighten them up. If packing is blowing be sure and report it on the book, slate or whatever is provided for engineers to make reports upon. Never report work unless it needs to be done. If you do, the foreman of the shop will come to the conclusion after awhile that you want to make yourself conspicuous, and will not pay much attention to your suggestions. After you go to your boarding house or home take a good wash and eat your meal. Don't go to some saloon that is frequented by a lot of railroad men and get to "blowing" what kind of a run you made, and that conductor so and so is of no account, and if you could get so and so done on your engine you could pull more cars than any engine on the road. Never do any railroading when you are off your engine; you have enough to do while there.

Before starting out always be around in time and see that "she" is all right, and has plenty of oil and tallow and necessary tools. Never depend on your fireman for anything. You should know those things yourself, and know also that the tank has enough water to take you to the first tank on the road. Approach all passing points and telegraph stations under full control. If you should have an accident, be sure and make out a correct report to the proper officers. If you are in the fault, do not try to saddle it on to some other person. If the superintendent orders you up, and you go before him, tell him the plain truth. If you are guilty of a misdemeanor, it is better for you to acknowledge it to him at once. By so doing it will relieve him of unnecessary investigation to find out who is the guilty party; besides, if a superintendent catches an employé in a lie, which he is sure to do if a lie has been told, he never puts any confidence in him afterwards.

Never talk ill about your fellow employés, and especially your officers. Be kind to your fireman, and be civil to strangers, for you do not know whom you talk to sometimes. Be sure you are right, then go ahead. In case of doubt, take the safe side.

SHOP AND ENGINEERING NOTES.

Editorial Correspondence.

AT THE RHODE ISLAND LOCOMOTIVE WORKS.

The indications are that considerably fewer locomotives will be built this year than were turned out to meet the demands of 1888; but during a recent visit to the Rhode Island Locomotive Works, at Providence, R. I., I could see no indication that they had begun to feel any influence of a reduced demand. They are working a full force of some 1,300 men mostly on heavy engines, ten wheelers and moguls being more in demand than the eight wheeler that still holds unmixed control of some railroads. Alarm has repeatedly been expressed at the dangers which were multiplied by the increased weight on the driving wheels of heavy passenger engines adapted to handle the trains now so common; but the various master mechanics concerned have been quietly overcoming the difficulty by designing ten wheel and mogul passenger engines. And, as far as I can learn, the more engines of this kind that are tried for the hard work to be done, the more the officers and men admire their performance.

The Rhode Island Locomotive Works are run in shops that were originally built for the manufacture of fire-arms, and they are not conveniently constructed for the building of locomotives. The business is also very much greater than the natural capacity of the works, and they are badly crowded for want of room, the tools in some places being set so closely that there is scarcely moving room between them. They manage, however, to turn out a great deal of work with little extra handling, and their system of contract work combined with the use of first-class tools, which are frequently to be found in very inharmonious surroundings, enable the company to put on the market locomotives that are built about as cheaply as those turned out of any other shops. A new pattern shop has been added to the works lately, and the greater portion of the wood-working department has been renewed and the most approved kinds of machines introduced. Among other improvements also noted were a new heavy punch and shears, new heavy steam-hammers, special cylinder shaper, special lathes for bolts, machine for finishing the six sides of a nut at one movement, and other tools of less note. They were also preparing to introduce into the iron foundry the use of molding machines similar to those that have been so useful in other works of this kind. They must have introduced steam riveting into these works long ago, for they have an old riveting machine in use which reminded me of Joe Smiley's mare, made famous by Mark Twain. Our sporting friends will remember that Smiley, who was a racing man, had a mare which was so slow and had so many disorders that they used to give her two or three hundred yards start and then pass her under way; but always at the fag-end of the race she'd get excited and desperate-like, and come cavorting and straddling up and scattering her legs around limber, sometimes in the air, and sometimes out to one side among the fences, and coughing and sneezing and blowing her nose, and always fetch up at the stand just about a neck ahead as near as you could cipher it down. This riveting machine is a multi-armed articulated lever arrangement, and it rattles, and jars, and groans when at work, but it grasps the rivet and plates with an unyielding grip and holds them there till the rivet is cool enough to resist drawing, when the hold is relaxed. When a master mechanic examines the work done by this ungainly steam riveter he is generally ready to give in that it is the best job of steam riveting he has ever inspected.

There was a great variety of engines in course of construction, and while examining the different kinds, it struck me that the different railroads, instead of working towards a few standard types, are industriously creating increased diversity. It used to be the fashion when a locomotive of a certain type was ordered from a builder that the makers' standard would be taken with only modifications necessary to make parts that have to be changed or renewed frequently interchangeable with the same parts of other engines belonging to the road. Now it appears to be a growing custom for every road to send detail drawings of each class and have the engines made to suit the taste of the head of the mechanical department. This is all right with large roads that have a large number of each class of engine, but with small roads it is mere expensive foolishness. There is considerable boasting about improving on builders' designs, but it is generally pretty hard for a disinterested party to distinguish where the improvement comes in.

Among the noteworthy engines which I saw on the floor was a special type of ten-wheel passenger engine for the Chicago, Milwaukee & St. Paul, and intended for the heaviest fast passenger trains. As far as I understand the situation, the railroad company named have had difficulty in getting engines capable of handling the trains satisfactorily, and they invited the Rhode Island Locomotive Works and the Schenectady Locomotive Works each to build an engine adapted for the traffic, with the understanding that the engine which does the work most efficiently will be adopted as a type. The Rhode Island engine has cylinders 19 × 24 inches; driving wheels, 64 inches diameter; valves, $1\frac{3}{16}$ inches outside lap; valve travel, $6\frac{1}{2}$ inches; ports, 18 × $1\frac{1}{2}$ and $2\frac{1}{2}$ inches; single exhaust nozzle. The boiler is of the wagon top type, 56 inches diameter at the smallest ring, of steel $\frac{9}{16}$ inch thick, longitudinal butt and welted joints. The fire-box goes down between the frames and is 78 × 34 inches, the crown being supported by bars. There is a brick arch supported on tubes and an inside deflecting plate to the fire-door. There are 236 flues, 2 inches diameter, and the boiler is clothed with asbestos covering. The working steam pressure carried is 180 pounds per square inch. There is 85,000 pounds weight on the drivers and 26,000 pounds on the truck, making the total weight in working order 111,000 pounds. The rods are all of channel section steel, with phosphor bronze bearings. The axles are also of steel. The engine stands high, is finished in a plain but artistic manner, and has an unusually handsome appearance.

Among others seen were some of the C., B. & Q. class H moguls, a class well known to our studious readers; some six-wheel switches for the Kansas City, Wyandotte & Northwestern, with cylinders 18 by 24 and wheels 44 inches diameter. There were some unusually ornate engines for the Providence & Springfield, with cylinders 16 by 24 and 62 inch wheels. There were orders from roads for several light eight-wheel engines of the type that most railroad companies are now willing to sell. But a good many of the parties that must buy light locomotives have learned that it is much cheaper in the end to buy new ones. Some of the worst impositions ever done in the way of selling, have been put upon parties buying second-hand locomotives. The New York & New England are getting some moguls that have considerable novelty about them. They have cylinders 20 by 26 and wheels 57 inches diameter. The boiler is straight, 60 inches diameter. The fire-box is above the frame and is 107 inches long by 43 inches wide. The crown is supported by bars of T-iron and the flues are screwed into the flue sheets. The valves are of the piston type.

Mr. Lythgoe, the superintendent of these works, happened to be absent while I was at the works, and most of the other officers were also away, but I was shown round and courteously treated by Mr. C. H. Batchellor, the able chief draughtsman of the works.

THE BROWN & SHARPE MANUFACTURING COMPANY'S WORKS.

I next visited for the first time the celebrated Brown & Sharpe Manufacturing Company's works, works that are quite familiar to the railroad man whose imagination inclines to reach back to the point of creation of tools daily handled. I long carried the company's card in my pocket in the form of a much-consulted steel scale marked D., B. & S., PROV., R. I., and the greater part of the small precise measuring tools used among most machinists of my acquaintance had the same inscription upon them; so I was somewhat acquainted with the firm before I had seen the universal milling machine or been in New England, and there are, no doubt, many other railroad men similarly situated. The works constitute the finest manufacturing establishment I have ever seen here or abroad. The general design laid down for a specific purpose, and the elaborating of the details for carrying on numerous complex operations, have been about perfect, and the entire management of running the concern is admirable. Although the place is of great magnitude and the products manufactured are of great variety, perfect order, pleasing neatness, scrupulous cleanliness and unrelaxed movement are found in every department, and be it in the floor where they are manufacturing sewing machines, micrometer calipers and such fine work, or in the department devoted to making rattlers for cleaning foundry castings, there are the same orderly conditions, and the air pervading that the room is a part of the B. & S. M. Co. establishment.

The following, which are the leading dimensions of the building, will give an idea of the extent of the establishment: The main building is 291 feet long by 51 feet wide, three stories and basement, with wings 50 and 75 feet long, making about 83,000 square feet of floor area. The second building is 195 feet long by 51 feet wide, four stories, with wing 41 feet long, making, exclusive of storage, carriage, reading room and lecture room, about 35,000 square feet of floor area. The blacksmith shop is 130 by 50 feet, and the foundry, exclusive of adjoining pattern shop, cleaning rooms, cupola house, wash and bath rooms, etc., is 265 by 70 feet. The buildings are of red brick, set on foundations of granite masonry, and all are built and finished with material not inflammable, and the machine shop is absolutely fire-proof.

This company manufacture a great many articles that are designed to be used in machine shops for specific purposes, the recommendation of a special tool being that it will do better work and more of it than a general tool. In their own operations the managers of these works have shown that they put this theory into practice as far as it can possibly be applied; for they have a very great variety of special tools at work, and I have seldom seen so many ingenious attachments used for controlling and facilitating recurring operations. Here milling and grinding have been developed to the utmost of their possibilities. The master mechanics who still look with distrust at milling machines and grinding machines ought to make it convenient to spend a day in these works, and they would be certain to go home wiser and more valuable men for the companies they serve; and if they are of observant habits, points on milling and grinding would not be the only information they would carry away suitable for home use. An impression prevails in many railroad shops that any bright boy can run a milling machine satisfactorily after a very little instruction. To spend a day watching the work finished by the experts in this shop with the milling machine is apt to upset the inferior labor illusion. I do not believe that it pays to employ a cheap man upon a good milling machine, unless for simple recurring operations.

The works manufacture a great many different articles and machines, and in some cases it appears that one set of men cannot be employed all the time on the same operations, so the next best thing is done—they are employed on repeated work till a full supply of the product is on hand. Thus, some No. 1 surface grinding machines are wanted, and an order goes forth that gets the bed and other castings belonging to the machine cast, and ten, twenty or thirty of the same thing are all made at one time. Platens and wheel spindles, and boxes and other parts originate at the same time from their several sources, and all begin traveling by their several ways towards one goal, the fitting-up room. A No. 3 screw machine may be the next thing wanted, and its parts will come in groups toward the finishing room in the way that the others did. The advantages of this system, which keeps men and tools as long as possible repeating an operation, are sufficiently obvious. Inspection of finished work is very rigidly practiced, and the minute measuring instrument which the company make, to enable others to reproduce parts accurately, are used very faithfully to test the accuracy of the company's own work. In fact I think that the system of limit gauges and some of the refined measuring instruments were developed to prevent Government officers from rejecting work through snobbish fault-finding, as we know some of them are in the habit of doing. It is well known that within the last few years a snob inspector has rejected tools made by some of our best makers, and that the circumlocution of government bureaus left the injured parties no redress.

These works are celebrated for their excellent sanitary arrangements, and for the admirable manner in which the buildings are lighted and heated. They have a finely fitted up washing room for the workmen, and in connection are rooms where each man has a place for hanging up his clothes. In addition to these the foundry has a number of bath rooms attached, where the men can thoroughly clean themselves. A library, which contains a large number of well-selected books, is provided for the use of the employés, also a lecture room and reading and writing room. These are said to be well patronized.

I was able to pay only a brief visit to the works and my notes are limited, but I am certain that it will repay any mechanical man to spend a whole day or more watching the operations and examining the work done. A. S.

Discussing Interchange Rules.

At the request of the Arbitration Committee of the Master Car-Builders' Association, most of the railroad clubs discussed the Rules of Interchange of Cars, with the view of agreeing upon required amendments. At the meeting of the New England Railroad Club,

Mr. F. D. Adams made an appeal for wording the rules plain enough to be understood by the inspectors. Wanted the rules to specify how large a piece must be broken out of a flange to change the term "chipped" to broken. Thought Rules 11 and 27 conflicted as to who should be held responsible for repairs done to private cars. Desired that to be made clear. Rule 19 makes a road liable for putting wrong material into a car, but he thought an exception ought to be made in the case of box lids. Believed that it was desirable to give roads permission to put in any good reliable draw-bar until there is a reasonable number of cars equipped with the standard draw bar. Brought up Rule 6, which gives any company the right to make the repairs on a carded car, and insisted that some roads made a practice of doing repairs where they were not necessary; called for more explicit directions about the making of repairs.

Mr. J. W. Marden felt assured that Rule 6 was badly abused, and he believed the remedy to be the use of two cards, one for old defects, the other for new ones. By this means the owner could be held responsible for old defects. Agreed with Mr. Adams in his views about box lids and draw-bars. If their cars are repaired with any strong, reliable draw-bar, it will be accepted by their inspectors. Hence had trouble where patent draw-bars on foreign cars have got broken on their system. They would put in their own standard, and when the car got home the patent bar would be put on and they would be charged $15 or $16 and nothing would be allowed for their own bar but the weight as scrap. They had refused to pay bills of this kind and had referred the matter to the Arbitration Committee. Believed existing system of interchange very expensive and thought it could be improved. There are two ways in which the repairs might be managed; we might take care of all the repairs of cars coming on to our road, making such repairs at our own expense, which would save a great deal of trouble in the matter of bills; or we might be allowed to make such repairs on foreign cars as would make them safe to run over our road, or if all would agree we might make these repairs permanent, in the way they

should be made, according to the style of workmanship in the car, and make a proper charge to the road owning the car, thus keeping the rolling stock in good condition all around.

Mr. Adams did not think that plan would work well, as the roads that habitually did inferior work with the cheapest kind of material would prey on the roads doing their work honestly.

Mr. J. N. Lauder deprecated the tendency to make alterations on the rules of interchange. Some minor points might be changed, and he favored double carding, so that old defects should be distinguished from new ones, but the rules as a whole he considered as good as anything that could be devised.

Mr. Adams thought that if Mr. Lauder's company did a large volume of interchanging with other roads that he would change his views about the interchange rules. Spoke again about the difficulty of collecting bills from owners of private cars that had railroad company's initials. Wanted it more explicitly explained who was responsible for such bills.

Mr. Lauder favored charging actual cost of repairs done to private cars which would be higher than the charges made against railroad companies. The private companies could not reciprocate in doing repairs, so be considered this would be just.

Mr. Adams agreed with this and favored changing the rules so that the cars of private companies should be debarred the privileges enjoyed by those belong to railroad companies under the rules of interchange.

Mr. Fletcher contended that the railroad companies were all ready enough to apply the interchange rules to the cars of private companies when it suited them. Thought it a one-sided affair all through.

Mr. Marden believed the rules of interchange needed revision occasionally because the inspectors understood them differently.

The Western Railway Club appointed a committee, consisting of B. K. Verbryck, C. A. Schroyer, G. W. Rhodes and W. D. Crosman, to report on the changes considered necessary on the rules. They recommended the following amendments:

Rule 3.

Clause *f*.—Add "Rims broken as indicated by dotted lines are defective and should not be accepted." (This refers to Fig. 5, page 7 of rules. If the rims are broken off on a line drawn vertically from the point where the chipping is shown to commence, then the wheel should not be accepted.)

Clause *o*, paragraph 5.—Your committee is in doubt whether springs with one inside coil broken should be accepted, and asks the club to discuss this point.

Clause *o*, paragraph 8.—Change to read as follows: "Dead blocks, wood unsound. Castings cracked through bolt holes, or broken, or improperly secured in place."

Clause *s*.—Insert the word "not" after the word "cars." Your committee also suggests that further restrictions as to condition of doors might be of value.

Rule 6.

Omit all after the word "done," referring to limitation of age of voucher.

Rule 9.

Add at end of rule the following clause: "Wheels with flanges or treads chipped or broken, for 6 inches in one continuous piece, resulting from seams or blowholes, shall be considered as broken or worn out under fair usage."

Rule 12.

Change the first three lines to read as follows: "Cars unfit for further service will be reported to the owner of the car. If the owner elects to have the car forwarded home it shall be regularly way billed at the expense of the owner. Such cars shall have a home card attached on each side of the body of the car. The cards shall be," etc.

Rule 14.

Add at end of rule: "No bill shall be honored for wheel and axle work if not presented within six months after work is done."

Rule 16.

Add to the parenthetical clause in line 6 the following words: "Otherwise the owner of the car must be communicated with."

Rule 17.

Add to second line after word "circumference" the words "and weight."

Rule 23.

Add to price list as follows:

BRAKES.

Air brake..... ——
Foundation gear for two trucks..... ——
Foundation gear for one truck..... ——

Also add to paragraph referring to depreciation (page 20) the words, "no depreciation allowed for brakes."

Rule 24.

Insert in third line, after word "trucks," the words "and brakes."

When this report was submitted to the club a very long discussion ensued, and great diversity of opinion was manifested about the proposed changes and regarding other sections of the rules.

At the Erie meeting of the American Society of Mechanical Engineers, Mr. D. W. Robb read a paper describing the old locomotive "Sampson," shown at the Chicago Exhibition of Railway Appliances in 1883. The engine was imported in 1839 from England for use on a mining railroad in Nova Scotia, and was kept at work till 1882. She was a very crude concern, even for that early day, and had upright cylinders and single return flue boiler.

Disputes Settled by Arbitration Committee of M. C. B. Association.

We have received from Secretary Cloud particulars of the cases brought before last meeting of the Executive Committee of the Master Car-Builders' Association for decision.

Arbitration case No. 13.—American Refrigerator Transit Co., in October, 1888, made bill against Texas & Pacific for repairs to American Refrigerator Transit Co. car which had a Texas & Pacific defect card dated February, 1888. Railroad company refused to pay bill because defect card was more than six months old when bill was rendered.

Decision.—That railroad company was liable for the bill under Rule 6 as it read when car was carded.

Case No. 14.—On Jan. 1, 1889, the Mobile & Ohio Railroad Company rendered bill against the Cairo, Vincennes & Chicago line for repairing one cracked truck bolster on Mobile & Ohio Railroad Company car No. 5,451, as per defect card of the Cairo, Vincennes & Chicago line, dated Aug. 19, 1888. This defect card is the same as the regular M. C. B. defect card, excepting that it has the words printed at the top: "This card is no authority to do the work." However, these words were erased by the inspector who placed the defect card upon the car.

The Cairo, Vincennes & Chicago Line people take exception to the bill, claiming that the defect was old and that the card was merely placed on the car to facilitate movement of the freight, and also that the car was carded according to rule No. 6 of the M. C. B. rules, and that the work done was not necessary to the safe running of the car, and in justice they should not be held for the old defect.

Mobile & Ohio Railroad Company returns the bill, stating that a defect card is authority for any company who performs the repairs indicated by the card, to render bill, notwithstanding the intentions of the party applying it.

After further correspondence, both parties agree to refer the case for decision to the Arbitration Committee.

Decision.—A M. C. B. defect card furnished by one railroad company to another, as per rule No. 4, when it delivers a car with defects, is a definite acknowledgment of responsibility for the damage noted upon the card.

It cannot evade responsibility by insertion upon the card of words, such as "This is not an order to repair," or in any other manner.

The defect card is a guarantee to the railroad company owning the car or making the repairs called for on the card that such repairs will be paid by the company carding the defects.

The claim made by the Cairo, Vincennes & Chicago line that the defect in the bolster was old has no bearing in the case, and is, therefore, no ground upon which to evade responsibility.

If the defect was old as stated, the Cairo, Vincennes & Chicago line might have avoided responsibility by refusing to accept the car in the first place, unless the railroad from which that company received it furnished a proper defect card.

Rule No. 4 of the M. C. B. rules affords ample protection to all. It implies careful inspection, and non-acceptance of defective cars, unless defects are properly carded.

If a railroad company fails to avail itself of the privileges granted under that rule, because of careless or no inspection, it assumes responsibility for existing defects.

Therefore, in the opinion of the committee, the bill rendered by the Mobile & Ohio Railroad Co. is proper, and should be paid by the Cairo, Vincennes & Chicago Line.

Case No. 15.—The Flint & Pere Marquette rendered a bill against the Wabash Western for replacing one wheel with cracked bracket and one bent axle under a W., St. L. & P. car. The Wabash Western declines to pay for the bent axle, stating that this is a damage and not a defect, and as they did not refuse the car as per Rule 3, the inference was that the damage was done on the Flint & Pere Marquette road. The latter road claim that they did not damage the axle, but that both wheel and axle were defective, and that the repairs and the charge were made in accordance with M. C. B. rules 9 and 13.

Decision.—It appears from the correspondence submitted that the Flint & Pere Marquette R. Company accepted the car in apparent good order. That being the case, the damage to the axle must have resulted while the car was in possession of the Flint & Pere Marquette R. Company.

Rule No. 9 only authorizes charges against the owner of the car for wheels and axles which fail under fair usage. A bent axle is not, in the opinion of the committee, covered by that rule, unless it is clearly shown that its strength was impaired by being worn below the limits established by the rules of the M. C. B. Association.

As the statement of wheels and axles drawn by the Flint & Pere Marquette Railroad does not indicate that such was the case, the committee is of the opinion that the objection on the part of the Wabash Western Railroad Company for the charge for bent axle is proper, and should be withdrawn by the Flint & Pere Marquette Railroad Company.

Case No. 16 was between the Northern Pacific and the Chicago, Burlington & Northern, and was analogous to case No. 13, and was settled in the same way.

Case No. 17.—The American Refrigerator Transit Company charged Houston & Texas Central the expense of bottom brake connection on one of its own cars carded by the railroad company. Houston & Texas Central decline the bill, stating that it was a case of faulty construction, and that the card was merely put on to expedite the movement of the car. American Refrigerator Transit Company return the bill stating that the repairs were done under an M. C. B. defect card in accordance with the rules of the Association.

Decision.—It is claimed by the Houston & Texas Central Railway Company that the damage was caused by faulty construction. If that was true, the railroad company had its remedy in refusing to accept the car. It was accepted, however, without protest.

It is not shown in the correspondence that the railroad company had at any time, previous to the occurrence of this case, notified the owner of these cars that it would not be responsible for the failure of such improperly constructed parts. Because of its failure to take these precautions, and because it furnished a proper defect card, which is a clear acknowledgment of responsibility for the damage on the part of the railroad company, it is the opinion of the committee that the charge is proper, and should be paid by the Houston & Texas Central Railway Company.

Case No. 18.—In December, 1888, the Missouri, Kansas & Texas Railway Company rendered bill against the St. Louis, Keokuk & Northwestern Railroad Company for replacing two draw-bars on M., K. & T. Car No. 4,074, as per defect card placed upon the car by the St. Louis, Keokuk & Northwestern Railroad Company, reading "Mixed draw-bars." The St. Louis, Keokuk & Northwestern Railroad Company takes exception to the bill, stating that the charge should be for only one draw-bar, as the other draw-bar was of the Missouri, Kansas & Texas pattern; and also cards calling for "Mixed draw-bars" are only intended to cover one wrong draw-bar. The Missouri, Kansas & Texas Railway Company claims that both draw-bars were foreign, and that two of their standard bars were placed upon the car.

Decision.—The St. Louis, Keokuk & Northwestern Railroad Company carded a Missouri, Kansas & Texas Railway car for mixed draw-bars. While the term "mixed" does not clearly indicate whether one or two draw-bars were foreign to the car, yet the general acceptance of the term has been that only one is foreign. The committee would recommend that the term "mixed" be not used, but that the words "one or two wrong draw-bars" be used instead.

The committee is of the opinion that in this case charge can only be made for one wrong draw-bar, because the Missouri, Kansas & Texas Railway Company had its remedy in refusing the car if it was improperly carded. By acceptance of the car without protest, it became liable for any defects that were not distinctly enumerated on the defect card. Therefore, the committee is of the opinion that the bill rendered by the St. Louis, Keokuk & Northwestern Railroad Company for two draw-bars should be changed, and charge made only for one draw-bar.

Work of the Master Car and Locomotive Painters' Association.

Mr. Robert McKeon, Secretary of the Master Car and Locomotive Painters' Association, announces the following work for the Association at the Convention to be held in Chicago next September:

Subject No. 1. "How shall we paint the 'heating parts' of locomotives, such as domes, steam chests, cylinders, etc., so as to insure against blistering, cracking and scaling, giving exact formulas for mixing and time required to finish complete."

Subject No. 2. "Standard formula for the inside finish of a first-class passenger coach. This to include filling, how mixed and applied; varnish, grade of; number of coats and time between coats; rubbed or dead finish."

Subject No. 3. "What constitutes the best filling for engin-driving wheels and other rough castings, quick work being considered; give exact formula."

Subject No. 4. "Is it advisable to discard the use of rubbing varnish on the outside of passenger, express, baggage and mail cars and use finishing varnish only, and do we obtain as good results by the use of finishing varnish applied 36 to 40 hours between coats as was obtained by the old method which required four or more days between coats?"

Subject No. 5. "How should a properly painted locomotive run before being cleaned and revarnished? What grade of varnish gives the best results—a hard drying or an elastic finishing?"

Subject No. 6. "What benefits, if any, do railway companies derive from allowing their foremen painters to attend the annual meetings of the Master Car and Locomotive Painters' Association?" Essay.

Subject No. 7. "Does a neatly striped and decorated passenger locomotive and train attract the eyes of the traveling public more than those painted very plain, and will the cleaning on the latter be done as effectually as on the former?"

Subject No. 8. "The Master Car Painters' formula for painting the outside of a passenger car, giving detail from priming to last coat of varnish; method with and without rough stuff." This duty was assigned to the Advisory Committee by the President at our last meeting to be reported at next meeting subject to approval or rejection.

QUERIES.

1st. Is it a benefit or a detriment to an under coat of paint to have an egg-shell gloss?

2d. What is the best way to test japan before mixing into paint?

3d. Should hard and soft boards be primed or treated alike to make a good lasting job?

4th. What is the best one coat of paint that will hold rust back the longest?

5th. What color will show up the best on a locomotive after eight or ten months in service—ivory black, lamp-black or Brunswick green?

6th. What is the best and quickest method for removing old, cracked, scaly paint from engine driving wheels, domes and other castings?

7th. Which is the most economical way to use gold leaf—to use direct from the book or to cut into strips to suit the striper, letterer, etc?

8th. Have we a chemical eradicator for rust?

At the convention of Railroad Commissioners, held at Washington two months ago, a resolution was adopted requesting the Inter-state Commerce Commission to obtain full information upon the question of Federal regulation of safety appliances on railroads. The Commissioners have now issued a circular calling for facts bearing on the history of State safety-appliance legislation and the effects of the same; the present condition regarding automatic couplers and the prospects of the M. C. B. standard coupler coming into general use, the progress in the application of train brakes to freight cars and to what extent freight trains are run without the necessity of brakemen traversing the tops of cars. The Commissioners also desire to know if Federal legislation is expedient, and if so what special administrative agencies, if any, should be appointed to carry it out.

Railway Car Construction.

BY WILLIAM VOSS.

Ninth Paper.

FREIGHT CAR TRUCKS.

The American car is distinguished from that of other countries principally by the peculiar manner in which it is mounted on its wheels. The old world practice is, with the few exceptions where our system has been copied, to carry the car on two pair of wheels so attached that their position relative to the car-body is unalterable. Some years ago, as a means to increase the length and capacity, a third pair of wheels was applied under the center of some of the English passenger cars. To provide for the proper adjustment of the wheels on curves, each pair had a frame separate from the body of the car, and all three frames were connected in such a manner that the lateral movement of the center pair forced those at the ends to assume a position corresponding with the radius of the respective curve. The experiment had to be abandoned, however, as the motion of the car on the springs was such that it was not fit to ride in, and that on the almost perfect road-beds of that country; it may be imagined how they would ride and how long they would stay on the track on some of our mud-roads.

The American freight truck consists of four wheels, two axles, four axle-boxes and a frame to which these are attached, and which transfers the weight of the car-body and load from its center through the boxes and journals to the wheels. The truck then, being center bearing and connected at one point with the car-body only, is free to move around this point and adjust itself to any position demanded by the curves, making it possible to run cars of great and practically unlimited length over very crooked and badly-lined tracks.

The wheels used under freight-cars are, almost without any exceptions, made of cast-iron, soft in the center and chilled in the tread and flange to make them more durable. Fig. 74 shows a wheel of the double plate, or the Washburn pattern, the one commonly used. The section outlines are such that the metal will not crack or be injuriously strained from unequal cooling when it is cast; the double plate, near the center or hub, braces it against lateral pressure with the smallest possible amount of material, and the brackets for the support of the flange are designed with the same object in view. A wheel of this kind, of the standard diameter of 33 inches, weighs from 500 to 600 pounds, varying with the capacity of the car it is intended for.

Much has been said, both for and against, the use of cast-iron or chilled wheels. Many considering it as unsafe are inclined to prefer one of the many steel-tired wheels. These are much stronger and would, if adopted, effectually settle the broken-wheel question; but as accidents traceable to broken wheels constitute but a small per cent. of the total accidents on a road, this feature alone cannot decide the question. Next comes the point of cost. A good steel-tired wheel costs about six times the amount a chilled wheel can be purchased for and is expected to give six times the mileage. The expense incurred for frequently changing the chilled wheels is about equal to that for turning the worn steel tires and changing of axles, as it takes about two to last the life of a tire. The scrapped chilled wheels are sold for nearly one-half of their original cost, while the scrap of the other is comparatively of but little value. But, assuming that so far the two accounts will balance, there still remains a very important item, that of interest on the capital invested. This is so great in the case of steel-tired wheels that it will almost equip a car with and pay for the renewals of chilled wheels.

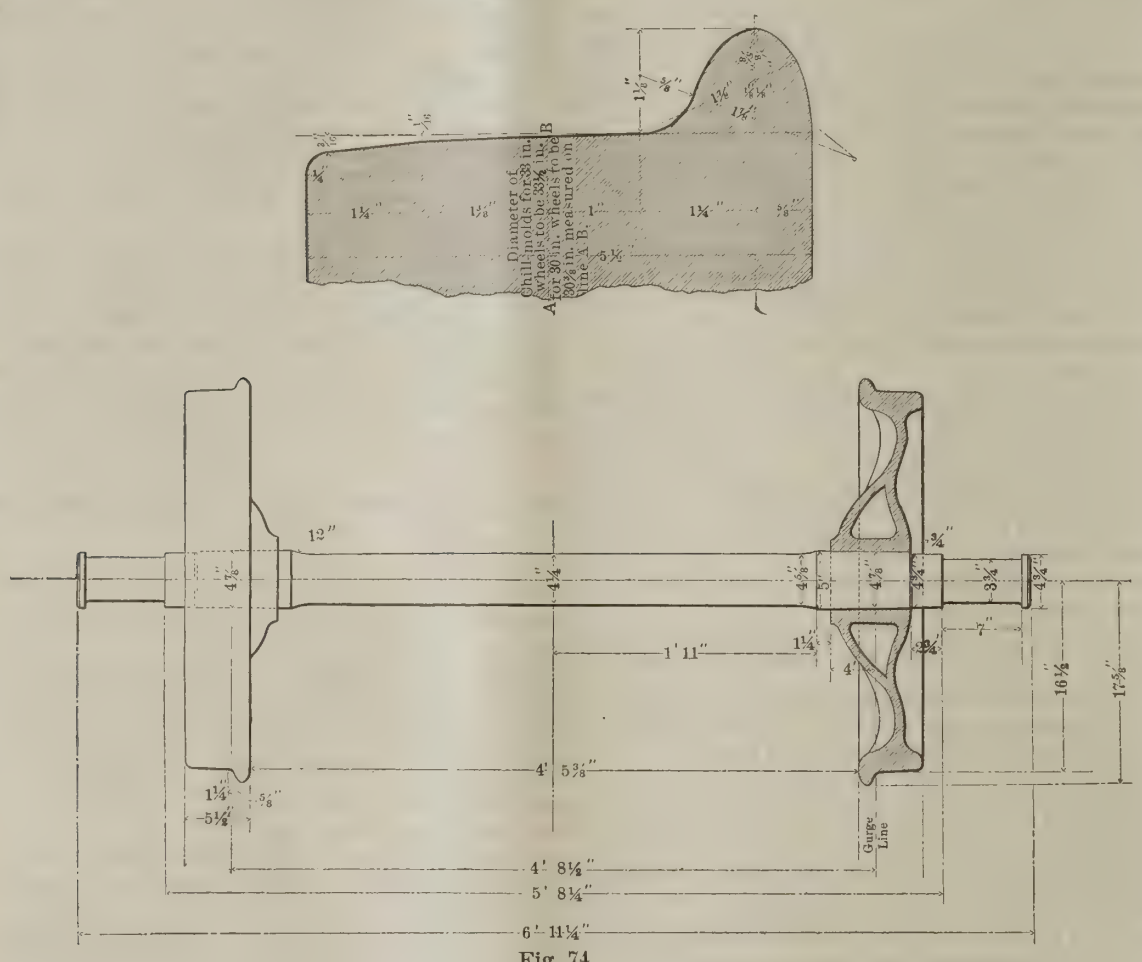


Fig. 74

Steel tires would give a much better mileage and be more economical in the end if it were possible to mate those of equal density and hardness, thereby securing an equal wear. As it is now, the softer tire, wearing more rapidly, is reduced faster in circumference than the other, and in trying to adjust itself to the new condition travels on that position of the tread having the largest diameter; that is, next to the flange, which soon is worn so thin and sharp that it becomes dangerous as well as ruined if not removed in time. While the tread and flange are being put into proper shape again by means of a turning lathe, a quantity of metal is removed that would under better conditions serve to increase the mileage; and the evil effect does not stop there, the mate of this tire, which should by reason of its greater density give a far greater service, has to be cut down to the size of the other, as long as it stays on the same axle. This difficulty with flanges is not in isolated cases only, but is so universal that wheels are never removed for any other cause than this; and until such a time as tires can be produced that are perfectly uniform in every respect, they will not be generally adopted, certainly not for freight service.

The outline of the tread and flange of a wheel, the distance between the backs of the flanges of a mounted pair, and the position of the hub on the axle have now all been established. The beneficial result of this measure will make itself felt after some years to the same extent as the adoption of a standard axle has; the interchangeability of a pair of wheels is made perfect, greatly lessening the annoyance and expense of this frequently occurring incident and the danger of derailment, and the breaking of flanges is reduced to a minimum.

The majority of axles now in service are made of the dimensions adopted for cars of 40,000 pounds capacity; the smaller sizes will soon be a thing of the past, and those for heavier cars are but just making their appearance. A standard size for these has, however, not yet been agreed upon, but the efforts made in this direction indicate an early settlement of the question; the journals of this axle will probably be of 4¼ inches diameter and 8 inches long, and the other parts proportioned to these.

Axles are made both of iron and steel. The relative value of the two materials for this particular part of the car having up to this time not been established, the iron axle continues to be in the majority, both because it is known what can be expected of it and because it is somewhat cheaper; but should it be demonstrated that the steel-axle is more safe even though its journal wear is not any greater, the small advance in cost would not stand in the way of a general adoption.

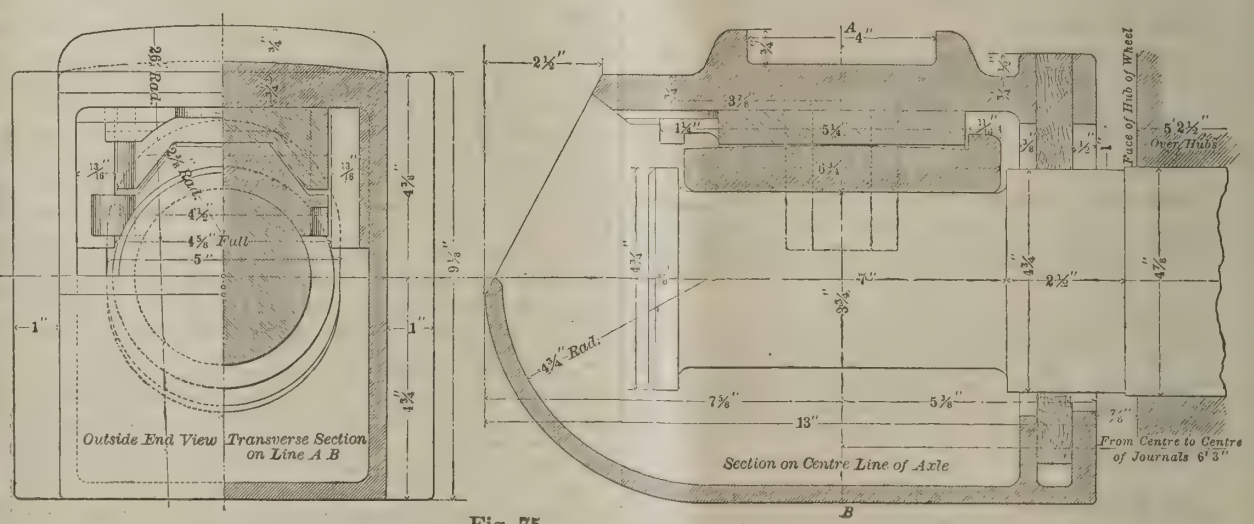


Fig. 75

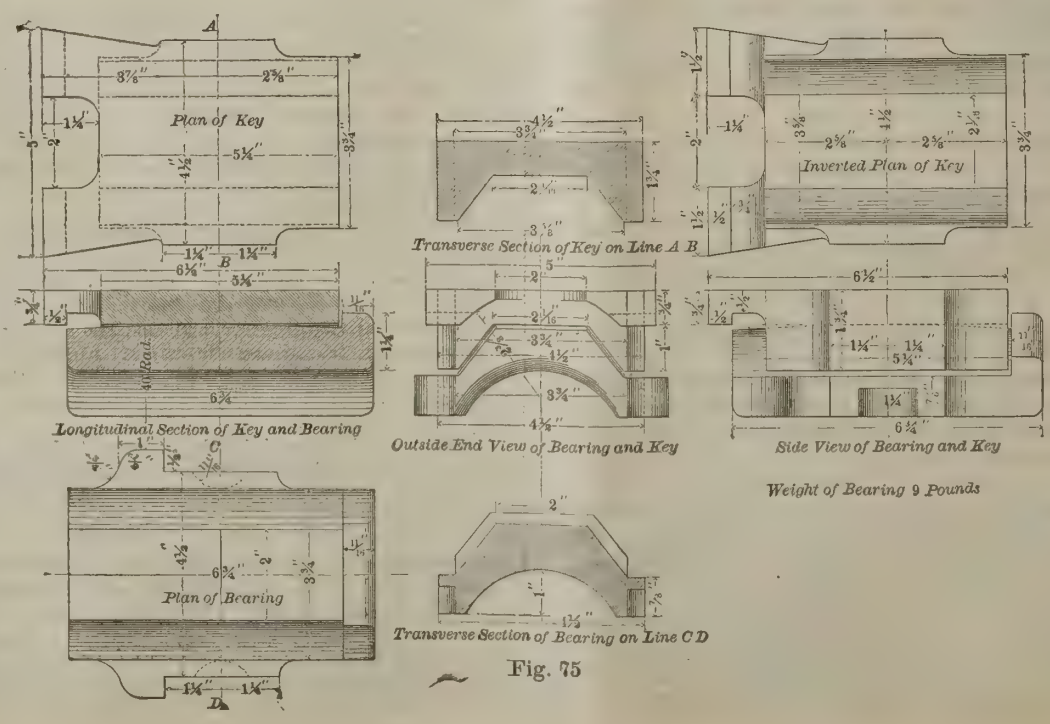


Fig. 75

The position of the wheels on the axle is secured simply by a close fit of the parts in contact; the necessary pressure for putting them together—which is usually assumed to be 50,000 pounds—is supplied by hydraulic presses constructed for the purpose.

The journal formed on the end of the axle and the bearing of anti-friction metal, in which it revolves, are encased in the journal-box, which is also designed to contain the lubricant, without which the rubbing surfaces would cut and heat, and to prevent dust and other irritating matter from entering. The latter functions are but imperfectly performed by the journal-box as at present constructed; the opening at the rear is necessarily larger than the journal, or rather the dust-guard bearing, $\frac{3}{8}$ of an inch being required below this to permit the introduction of a new bearing, and 1 inch above it to wear this bearing out. A dust-guard of wood, or some stronger and more durable material, with a snug fit on the dust-guard bearing, and sliding vertically in a pocket or guide, constructed in the rear part of the box for the purpose, is the means adopted to stop these openings, but will not do this oil-tight even when new. Of course, the one gallon of oil requisite to pack a box is supposed to be absorbed by the fibrous packing and to be given out only as needed by the journal; but the journal by its constant and sudden lateral motion extracts a portion of the oil and allows it to flow or forces it through the crevices in the back of the box. The dust-guard is in practice but a poor fit if not wholly absent. The reason for this is that it is so difficult to get at and is renewed only when wheels are changed; and as this is usually done in a hurry, but little attention is paid to it then. But it is always more simple to point out the faults than to propose the remedies. The numerous attempts made to provide a compensating and substantial dust-guard, and a smooth and finished guide for it to work in, have all signally failed as impracticable and too expensive.

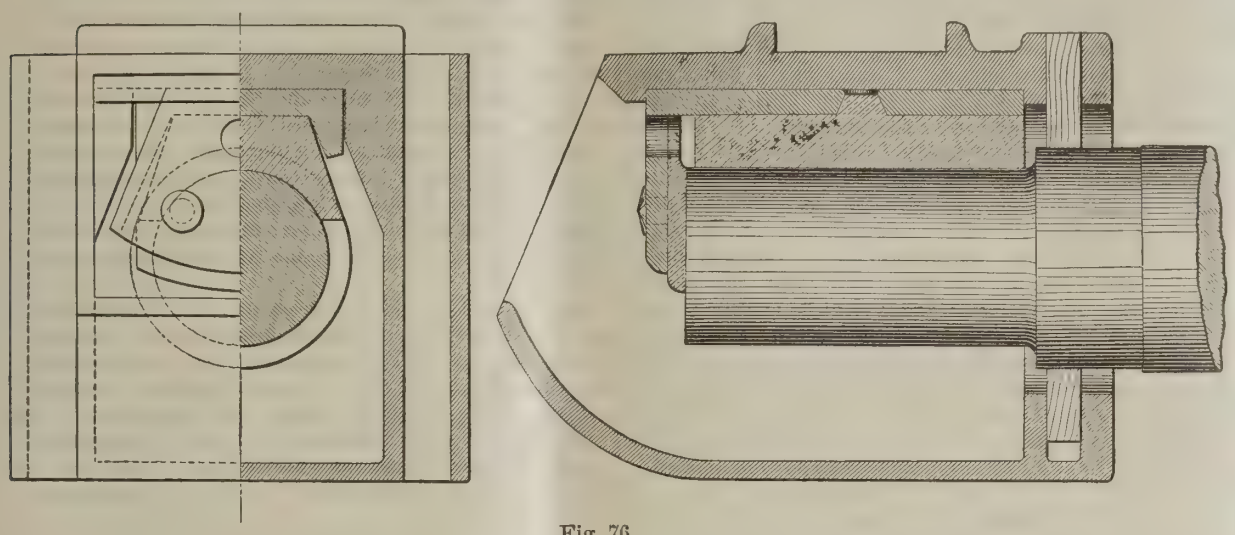


Fig. 76

The lid or cover of the box, by reason of its usually imperfect fit and the difficulty in devising an adequate fastening for it, is another detail which it is desirable to have improved. The old-fashioned slide-cover of either wood or iron is therefore still much in vogue; it being the cheapest and least difficult to fit and apply, although it is objectionable in that it is very liable not to be there when wanted. The forms of covers most extensively used in addition to this are shown in connection with drawings of trucks accompanying these articles.

The journal bearing is kept in its proper position in relation to the journal by a slide or key, preferably of malleable iron, this material being better adapted to bear the heavy pressure it is subjected to. The object of the key is to allow the bearing to be worn to the greatest possible extent before it is renewed and also to allow the new one to be inserted with the least possible jacking up on the box, which consequently admits of a higher back under the dust-guard bearing.

The metal for journal bearings must combine with its anti-friction quality that of tenacity and strength sufficient to prevent distortion and crumbling under the heavy loads carried. The best common composition known is an alloy of copper and tin in the proportion of about eight of the former to one of the latter. To insure a bearing of this composition to run cool it is essential to have a perfect journal and fit, but this is in practice impossible to obtain under all circumstances. A journal reduced from its original diameter by wear requires a bearing ground or bored to a different radius than that intended for a new one, and to accommodate all the different diameters a large stock of bearings has to be kept on hand. The journal also becomes slightly concave, owing to the elasticity of the center bearing brass, and cut or rough when it has been running hot. To bridge over these difficulties the new bearing is faced with a thin lining of some yielding metal, such as lead. This adjusts itself readily to the shape of the journal after a few revolutions of the latter, and as it wears away brings the harder metal underneath gradually in contact, and by the time it is entirely gone leaves the brass and journal an accurate fit.

Babbitt metal, an alloy of lead and antimony, possessing the quality of furnishing more wear for less money, is made much use of for car axle bearings, but its inferior strength necessitates the employment of a brass shell, the cavity of which contains the weaker composition. Very good results have been obtained with this bearing when properly constructed, although the journal on which it is used wears away more rapidly. There is, however, one instance where it is rather troublesome and inferior to a solid bearing, and this when it is placed on a rough or hot journal, which of necessity continues to run warm until again reduced to a proper surface. In this case the babbitt is very liable to melt and run out, leaving the insufficient surface of the shell alone to absorb the friction, a condition resulting in a hotter instead of the desired cooler journal. On roads where filled bearings are used, a stock of solid lead-lined brasses should be provided at the inspecting stations and issued to the trainmen to be used in such emergencies.

Fig. 75 shows the journal bearing and box in their various positions, and of the dimensions as adopted by the Master Car-Builders' Association, and as now in universal use.

The construction of the journals and bearings so far described is faulty, in that the end wear due to the lateral motion is not sufficiently guarded against. The bearings are so rapidly reduced at the ends that they have very often to be removed for this cause and long before they are worn out in the other direction. The collar on the outer end of the journal wears also very fast, especially so with lined or filled bearings, and an axle is frequently condemned for want of a collar when it is otherwise in good condition. A remedy for this is at hand in the collarless axle and the end stop shown in Fig. 76, and it is surprising that so comparatively few have availed themselves of them. It is by no means a new thing, having been in successful operation long enough to establish its merit beyond a question of doubt. With the collarless axle the packing is also much less disturbed and less of the oil wasted, the dust-guard is kept in better condition owing to the checked lateral motion, and the lid or cover made less difficult to keep in order.

Oiling Valves Under Difficulties.

Something over twenty years ago, while a locomotive fireman, I was called one morning to go to the roundhouse and go out on "No. 28." After oiling the machine, I took hold of the throttle to run it out of the house, but found it apparently immovable, and, having had some experience with hard-working throttle valves, I concluded to leave it for the engineer. When the engineer came—a stout, brawny man, to whom the engine was strange—he took hold of the throttle, but did not start it; gave it another pull, then looked and meditated. Finally he managed to get it open, and started off on the road. The first time steam was shut off he resorted to the well-known trick of putting a good, liberal quantity of oil in the cylinders—the only time cylinders could be oiled in those days—then reversed the engine, which transformed it into an air pump, to pump air into the boiler until the throttle was lifted from its seat and some of the oil deposited there, when the throttle worked all right.

In those days they had no automatic feed, and the amount of oil used was what you could afford. I never knew too much to be used for easy working of the valves. "No. 28" was very irregular about water, and flooding the cylinders was a common occurrence, and when water had gone over at the first down grade, the oiling and reversing was gone through with, or else the throttle got caught. I think this is one reason why valves wear faster on locomotives than on stationary engines. The water from the boiler is more apt to get thrown over into the steam pipe, and from the heavy draft of steam at times it must be very wet, all of which tends to wash off the oil, and while it may not scratch the surfaces, the wear will be greater for it.

A stationary engine supplied with steam from a boiler that gives wet steam will require more oil and more repairs to steam surfaces. An engine with uncovered steam pipe will also require more oil and repairs than with one covered.—*W. E. Crane in American Machinist.*

Mr. T. F. Oakes, President of the Northern Pacific, contributed an article on "Some Results of the Inter-state Commerce Law" to Frank Leslie's illustrated paper of May 25. Mr. Oakes expresses the belief that most railroad managers are agreeably disappointed with the working of the law, for it does not cause them so much inconvenience as was anticipated. To railroad companies in the eastern and middle States he thinks the law a decided advantage, to railroads in the belt between Chicago and the Missouri River the operation of the law is not altogether satisfactory, and the effect of the law on the railroads in a few western States is to curtail the ability of the managers to develop the settlement and business of the territory reached. The law acts in a manner even more detrimental to the interests of settlers than to the prosperity of railroad companies, and numerous illustrations of how this happens are given. Mr. Oakes, while commending the Commission as a whole, alludes to the fact that all the members are lawyers, and regards this as a weakness which ought to be removed at the earliest opportunity by the appointment of a practical railroad man as a member of the Inter-state Commerce Law Commission.

The Pullman Shops.

The unsatisfactory condition of manufacturing establishments which depend upon railroad patronage is well shown in a recent statement published concerning the Pullman shops at Pullman, near Chicago. This report says that among the cabinet-makers and carvers there are usually from 400 to 500 at work, while now there are not over 200. There are less than 60 in the foundry, while there ought to be 700. No work is being done in the steel mill, and 300 men are idle, but it is expected enough work will be on hand in this department in a few days to last a month. There are 150 men in the iron department, while usually there are 500 or 600 at work. In the freight shops only 40 out of 400 or 500 are at work, and these are just finishing up a few caboose cars. Work in this department is slack because of a lack of material and because a new Corliss engine is being put in place. In the store-room the force has not been cut down, but the wages have. The men who received $1.50 per day now get $1.25, and the chief store-keeper's salary has been cut from $150 to $120 per month. Less than 100 men are now working in the lumber yard, where the regular force is from 200 to 250. The helpers of the steam-fitters have been cut from $1.50 per day to $1.25 per day, and over a dozen have left their work. Some 25 men were laid off from repair-work on the 8th inst. The wood machine department was closed down week before last, and unless more work is forthcoming the claim is made that but very few men will be employed in the Pullman shops in a short time.—*Iron Age.*

A Delusive Invention Field.

Some time ago, when Uncle Cyrus W. Field controlled the elevated railroads, it was announced that one of the younger generation of Fields had solved the problem involved in applying electricity to the traction of loaded cars. Forthwith that spur of the Third avenue road which runs from the main line to the Thirty-fourth Street Ferry station was given over to the experimental performances of a curious vehicle that ran backward and forward with great rapidity. It was always operated by a very nice young man, in a very nice suit of clothes, who always wore a very sweet and self-satisfied smile on his delicate features. Superciliously indifferent to the ill-repressed admiration of Second avenue shop girls, he fairly basked in the flattering comments of the belles of the "uppah clarss," who used to pointedly inquire who he was and remark "Ah!" in a tone of tender interest whenever the polite brakeman identified him as "Mr. Field, the inventor." Mr. Field, the inventor, ran up and down the spur in a weirdly fascinating but not altogether intelligible manner for several months, and then, all at once, he vanished from the admiring view of the ladies who had grown to regard him as one of the special attractions of the elevated system. The queer machine in which he used to flit from end to end of his abbreviated route now cumbers a siding, and both dust and rust have combined to make it uglier than ever. But Mr. Field, the inventor, no longer wields its lever; no longer for Mr. Field, the inventor, are the soulful orbs of fascinated maidens turned upon its deserted cab.

I inquired the other day why Mr. Field and his invention should have parted company in such a distressing way. My informant says that after Mr. Field had invented his chariot for receiving electricity from a cable, with a view to linking thereto a train of cars, an engineer in the main office was asked to calculate the horse-power and other conditions involved in the dynamo. I'm not sure of his figures, but I rather think he discovered that Mr. Field's invention would require something like 50,000 horse-power at the terminal, and that a cable conveying the necessary energy would in three minutes melt into a red hot fluid and spill into the strects. At all events that is one of the explanations confidentially offered to you when you ask why Mr. Field, the inventor, is not hobbing serenely along between Thirty-fourth Street Ferry and Third avenue these pleasant May days.—*N. Y. Sun.*

Communications.

High and Low Water Levels in Boiler Feeding.

Editor National Car and Locomotive Builder:

There is a point of locomotive operating about which there is much diversity of opinion among the men who have charge of the engines while at work, and which, because of its important relation to the economical performance of the engine should be discussed.

The opinion prevails to a large extent among locomotive engineers that it is best to keep the boiler as full of water as possible and avoid priming, in order to have the engine steam freely. In short, that engines steam better with full boiler of water, or say with full glass of water, than with it half or one-third full.

When a reason for this belief is asked for one is told the reason is that the temperature of a large body of heated water is less affected by the injection of colder water than the temperature of a small body of heated water would be, therefore an engine will steam better with full boiler.

Falsehood, we are told, is never so deceiving as when accompanied by truth, and I believe that in the foregoing proposition we find truth in bad company.

Each pound of water of 50 degrees temperature requires 1,175 units of heat transmitted to it to convert it into steam of 145 pounds pressure, regardless of whether it be a pound of a large or a small body of water.

This being an established fact, the claim that the same amount of heat imparted to a large body of heated water will make more steam than if imparted to a smaller body of heated water, is without foundation. In practice, all that affects the steaming of an engine, so far as boiler feeding is concerned, is, *not* how much water is in the boiler, but *how much*, and *when* water is fed to the boiler.

An engineer, believing a full glass of water is necessary to get steam, starts out, and if the fire happens to be in poor shape at the start, he is compelled to leave the injector off awhile, and of course the water level falls in the glass. So by the time the train is forced into speed he has but half a glass of water. Being anxious to have the boiler as full as usual, the injector is started as soon as possible, and adjusted to feed more water to the boiler than what is being used as steam. To illustrate the evil results of which, we will say the engine has 145 pounds steam pressure and is pulling a train at the rate of 20 miles an hour, and using 400 pounds of water per mile. The fire must be kept sufficiently hot to convert 400 pounds of water in the boiler into steam every three minutes, or 133 pounds every minute, if the injector supplies boiler with an exact equivalent to what is being used as steam.

If the injector is made to force 500 pounds of water into the boiler per mile run, or 160 pounds per minute, there will be a surplus of 33 pounds of water entering the boiler, each minute, above what is being converted into steam and used. This amount of water would hardly be noticeable in the glass at first, as in a minute it would increase the column of water there only about one-eighth of an inch—but it affects the coal pile.

Each pound of this surplus water, on entering the boiler, absorbs sufficient heat to raise its temperature to that of the water in the boiler, 365 degrees, which requires 315 heat units per pound. The 33 pounds will absorb ($33 \times 315 =$) 10,395 heat units. So, in order to keep up steam, the fire must be forced to the greater intensity necessary to communicate over 10,000 units of heat more per minute to the water in the boiler than if only the proper equivalent had been supplied. This, too, at a time when the fire is already taxed heavily to furnish heat for the formation of steam being used.

It would require an unusually excellent steamer to make steam freely under such circumstances, and as ours is but an ordinary every day engine she lags in steam, and the engineer cogitates on the evil results of letting his water level vary from the topmost notch.

An engineer who, when his water fell to half a glass, would be satisfied to keep it there, and would adjust the injection accordingly, would find no difference in the steaming of his engine whether he had a full or only half a glass of water. Should he be an engineer of modern ideas he would adjust the injector, even then, to feed a *less* amount of water than was necessary to hold the water-level at half a glass, but would allow it to gradually fall to a third, or a quarter of a glass in running to his next stopping place; when, while engine was with steam shut off running into and stopping at the station, the store of water could be recuperated most easily.

Next to carefully using the expansive force of steam to the greatest possible strength consistent with good work, careful and proper boiler-feeding affords the greatest opportunity we have to economize in the use of fuel in locomotive operating, and engineers who practice keeping their boilers as full of water as they can, and those who try to keep the water-level at as near one point as possible (I have heard them boast that a string might be tied around their water glass, at a certain point, and the water would always be right there), do not utilize the advantages that are offered by the heat-storing quality of water. Such practices are well enough in stationary engineering, where the work is constant; but in locomotive engineering, where the work required is constantly fluctuating between the maximum power of the engine, and no work at all,—such as when engine is shut off running down hills, and into and stopping at stations,—they are full of evil results to the coal pile.

An engineer abreast with his profession, and understanding that a boiler properly full of water under 145 pounds steam pressure represents an immense store of heat, which, as his locomotive is simply a heat engine, is a capital stock to start with, does not aim to *keep* the boiler full or the water level at one point,—far from it. He aims to draw upon the stored heat in the boiler to assist his engine to economically perform the hard task of starting the train and forcing it into speed, and does so by leaving his injection off at such times and drawing upon his store instead of upon his fire for a large amount of the heat necessary for the work.

In this way, and by adjusting the injector at other times to feed a *less* amount of water to the boiler than what it is parting with as steam, he draws upon the store of heat represented by the full glass of water, as far as it is practicable, possibly to a third, or a quarter of a glass, thus *favoring* his engine all he can while it is engaged in performing hard tasks of work, knowing that when he shuts off for the next station, or to run down the next hill, he will have an opportunity to refill his boiler with water and recuperate his store of heat, and that if, while doing so, he guards against falling steam pressure and therefore against changing temperature of his boiler, he prevents all possible injury to the same and its flues. By carefully following this method he saves his fireman a great deal of unnecessary work and his employer a handsome sum each month in the operating expenses of his engine.

GEORGE H. BAKER.

Rules of Interchange.

Editor National Car and Locomotive Builder:

The leading question that now agitates the minds of the master car-builders of the country is, What can be done to improve the code of rules of interchange? The railway clubs are discussing it, as are master car-builders and others interested in the all important theme, how to best facilitate the prompt interchange of business. Not only the master car-builders but the freight department officials are deeply interested, for the mystic wand of the ever-sufficient "car inspector" can, with one wave, obstruct more business in a day by a wrong interpretation of the rules than would pay his salary for a year. Such is almost an every-day occurrence, under existing rules. That there is room for improvement goes without saying. One and a half days were spent (or wasted) at Alexander Bay last June in a vain endeavor to revise the rules and tack on a lot of so-called interpretations; what was the result? It was but partly done, with no particular credit to the association or benefit to the interchange of cars. Believing that a more systematic method of revising the rules each year, was necessary, Rule 30 was revised to meet the emergency, and a committee of five was appointed, to be called the Arbitration and Revision Committee.

This committee, by the power delegated to them, have asked for suggestions of changes, amendments and additions to the rules as they now stand. It is to be presumed that they will compile all the information they receive with their own valuable experience of the year, and present to the association at the coming convention a very superior revision of the code to anything we have yet had, and that when it is read the convention will only have to say aye to it.

A few of the points that might be considered for revision are: 1st. The "defect card." Would the two-card system be advantageous? If the joint car inspectors had the directing of it there would be two cards; one for which the car-owners only are responsible, the other holding responsible the road applying the card. The association would do well to give it a trial.

2d. Revision of the "price lists." Should these lists, viz., cars, wheels and axles and materials not come under one head or rule?

3d. As there are a large number of heavy capacity cars in service, should not a rule be formed to cover the weight of wheels to be accepted under such cars? Too often we see wheels under 60,000-pound capacity cars put under at interchange points that are too light. If the limit were set, when such a car reached home, and wheels were removed that were below the limit in weight, the company putting such wheels under could be billed for it; thereby making the road that put the light weight wheels responsible.

4th. A more extensive interpretation of the rules might be of advantage. Should not the interpretation be in the form of an appendix? as they are only referred to occasionally, the rule being the main thing wanted.

5th. If Rule 27 conflicts with Rule 11, Rule 11 might be made to read, "providing the case does not conflict with Rule 27." As both rules are necessary, the above proviso will certainly obviate any trouble contemplated by some.

6th. Regarding wrong material, especially oil-box covers and draw-bars: Doubtless many roads are enforcing this Rule 19 too stringently, as there is no standard oil-box cover, and the so-called standard draw-bar is quite a distance from universal adoption as yet. A provision should be made in the revised rules to cover "oil-box covers and draw-bars." A draw-bar should be accepted if it conforms to the original in general dimensions, such as length from pin hole to follower and outside dimensions over followers. As it is quite evident that the draw-bar question is a long ways from final settlement, the importance of a more lenient rule covering that vexatious point in car interchange is obvious.

7th. Rule 12 is rather vague. It should show the responsibility, in case a car unfit for further service, with home card attached, should break down on an intervening road over which the car has to pass to reach home. The owner certainly should be responsible if the car is damaged in ordinary service, but the road handling the car should pay for damage done by casualty. The rule needs revising to cover these points.

8th. The duties of the Arbitration Commitee are not properly understood by some parties. They seem to think that the committee have power to go beyond the rules to settle disputes. Rule 30 might be made plainer on this point by changing the latter section to read, "In case of any dispute or question arising under the rules, the same, *by mutual consent of both parties interested*, may be submitted to this committee, whose decisions shall be *by the rules*, and final and binding upon the parties concerned." The words in italics are new, and certainly make it definite enough.

9th. Rule 31 would doubtless be more satisfactory if made to embody a very worthy class of master car-builders, I mean the "active membership" of the association. The rule should read after the word purchase, "and each active member present." Many roads subscribe to the rules, but are only represented by active membership; being subscribers to the rules they should certainly have a vote in the formation of them.

INTERCHANGE.

Misinterpretation of Interchange Rules.

Editor National Car and Locomotive Builder:

Referring to my letter in your March number in regard to the interchange of traffic, please accept thanks for the prompt attention given it. I had hoped that some of our master car-builders would act on your suggestion and give their views in the matter, but thus far they have failed to respond. While the M. C. B. code says that wheels may be refused for flat spots 2½ inches long, or flanges having flat vertical surfaces extending more than one inch from head, there are railway companies here that claim, according to M. C. B. rules, that they need not accept a car that has a wheel flat 2½ inches or flat vertical surface on flange extending one inch from tread either with or without a card, and that they can demand a release card for spots on wheels as small as one inch and flat vertical surface on flange ½ inch, claiming that they are defects, and according to M. C. B. rules they can demand a release card, and in the past four months one company on transfer at this point has compelled a connecting line to give them from 10 to 25 release cards a day for just such defects. You can well understand the unnecessary trouble and expense such business causes, besides the delay to freight. I hope at the convention of the Master Car-Builders' Association in June that these points will be made clear and decisive, and I think it would save a great deal of time and money to the companies interested, as well as delay to freight, if these points were brought out so that all parties interested would understand them the same. At present there is a wide diversity of opinion as to the ground covered. If the honor you say should be among railway companies in their dealing with each other always existed, the present M. C. B. code might settle all disputes; but as there are a number of roads throughout the country that do not seem to be blessed with this virtue, I think the rules should be more definite, as there is considerable interest throughout this section among different parties concerned. I would be pleased to hear from you further on the subject.

MINNEAPOLIS INSPECTOR.

Interchange of Cars.

Editors National Car and Locomotive Builder:

What are the objects, advantages and amount saved by railway companies doing business the way they do? In the first place, years ago railway managers must have considered it important that a car could be loaded at one end of the continent, and consigned to the other without transfer, or the idea of making the different railroads of a uniform gauge would not have been considered; and as the advantage appeared each succeeding year more clearly a consummation of the same is now almost universal. The advantage would appear in time saved and bulk not broken, giving the consignee no chance to say in the numerous transfers that the contents were damaged and such an amount is required to make the loss good. To approximate the amount represented of coal, iron, merchandise, etc., that is carried by the numerous railways and distributed through the different States, also for export, to say the least, is enormous. Do railway companies take into consideration the facts? If so, why is the interchange hampered in every conceivable way by some companies? Should not the amount of business done through interchanging cars have some weight? Should a whim or an impecunious policy be resorted to by one com-

pany, which would have the effect of counteracting the good results that have been achieved and which are yet but half way to the pinnacle at this time? In making changes or adopting something entirely different from any of the other companies, when the merit of the same is doubtful, goes far towards unhinging the good results already accomplished, or giving orders for the selfish purpose of downing another company wqo is a little weak in some particular, is another mode of procedure very often resorted to, and which does not add to the accomplishment of this vast carrying trade. It is not my idea to go into details at this time, only so far as to show the immense amount of business done in this way and the object should not be considered individually but as a whole in each department concerned.

J. C.

Car Building Interests.

Editor National Car and Locomotive Builder:

I am glad to see from time to time articles in your valuable journal expressing the opinions of different men in regard to the various parts used in railway car construction. These discussions bring suggestions that might not have occurred to the minds of those interested and serve a good purpose.

If a freer expression of opinion on the different subjects relating to cars were had at the proper time after careful study, better results would be accomplished.

In your May issue I notice an article on oil box covers, also one on the car coupler question, some points in both of which are well taken.

I would like to say, in reference to oil-box covers, that they, like other parts of cars, have some objectionable feature about them.

We have ordered the "Morris Box lid" for about 200 cars and the "Hewitt" for 100 cars on our line, and will give them a fair trial. We think that the light weight, toughness and ease of adjusting the Morris lid are points in its favor. But, however, both the covers alluded to are to demonstrate with us what they will do. We are satisfied that both have merit.

In reference to the M. C. B. type of car coupler I wish to say that we have about 400 cars equipped and in use, with one make of this type, with very satisfactory results as to the coupler proper. The unlocking device has occasioned some trouble to keep in order, otherwise they have worked very successfully. One trouble is the slowness with which railroads take hold of the standard type of car coupler which has been adopted by the M. C. B. Association after years labor.

I think that the liability to accident is being gradually diminished by those railroads that have adopted and are applying the M. C. B. standard coupler. There is now and will be some occasional difficulty on account of the ordinary link and pin head coming in contact with the standard type, a more general use of which will furnish a remedy for this difficulty.

The several standards as adopted by the M. C. B. Association have done much good, and have aided considerably in giving dispatch to cars, and I trust that the type of coupler as adopted by them will find its way into general use, which it is likely to do sooner or later. I say, speed on the good work.

J. D.

Favors an Open Throttle.

Editor National Car and Locomotive Builder:

I see in most all mechanical papers something about the effects of throttling or the effects of not throttling. I think if some of these half-open throttle men were to fire a while for a man that throttled the steam, and then for a man that did not, they would be convinced by experience that the man who runs with wide open throttle, and puts the reverse lever where it will do the work, is the best man. A great many engineers and firemen claim their engines won't steam with full throttle and lever near the center, but in most cases I think it is the fault of firing, for I have never found one yet that would not steam better. It is a well-known fact that a Corliss engine is a more economical engine than a locomotive, one reason being the automatic cut-off, which is governed by the governor to suit the load or work the engine is doing, initial pressure being the same all the time and as near boiler pressure as it can possibly be. Now, is it not just as sensible to use as near boiler pressure as possible in a locomotive and use the reverse lever as a governor? I see in one paper where a man is all the time talking about reverse lever being too near the center and one or two notches being too much, and, besides, tears up his fire. If he will use larger nozzles she will not tear up his fire and do better work. If one or two notches is too much, drop a bolt or spike in the notch ahead of lever and rest the lever against it, then you will have half notches. All engines should have a reverse lever that could be set as fine as desirable. Some engineers claim running with wide open throttle, and putting the reverse lever where it will do the work, is hard on the engine; but during my six years' experience as a machinist and two years' firing, I notice the wide open high pressure man keeps his engine out of the back shop the longest, and runs the longest with a set of flues, uses the least coal, makes the best time and is the easiest on fireman, although he hollows out his valve seat worse than the half open, old-time runner does. But it only takes about eight hours' work to square up a valve seat and twenty-one years to make a man, so let's not kill him by running with half-closed throttle and burning from one to three tons of coal more than the man who pulls her open and hooks her up and is not afraid of being thrown out of the front window if he tries to give her another notch. Let her go, and see what she will do.

A. J. HILL.

Oil Box Covers.

Editor National Car and Locomotive Builder:

I see some person has taken issue with my notes on "Oil Box Covers." I don't see that he has made any points worthy of notice more than to show that he is working in the interest of the "Morris box cover," which I am free to admit is a very good cover of the kind, *i. e.*, the spring hinge, one of the weak points of which is the rivet that holds it to the box. "Observer" seems very quick to see the weak spots of improperly constructed Hewitt covers, and to state that a properly constructed Hewitt cover and box costs too much. He must be surely joking when he says that. If not, how can that be, if the pattern is first made properly? The castings therefrom will certainly be all alike. Then how can it cost more, being a plain casting, either soft metal or malleable, with no fitting, no bolts, no springs, no rivets, which can not be said of any other cover. As to royalty, the patent has run out or I am wrongly informed. How about other box covers in the market that are patented? Very few, if any, are free of royalty. As the oil box is subject to more hard pounding than any other part of the car (except the wheels and axles) is it not absolutely necessary that there be less parts subject to wear and tear than any other part? As this will hardly be disputed, am I not safe in asserting that the "cover" with the least wearing parts and that fulfills the requirements of an oil box cover the best—*i. e.*, economy in construction, maintenance and operation—is the best? My interest in this question of oil-box covers is unprejudiced, merely to see the best used.

It is only necessary for a person to take an eye-interest in the great interchange yards for a year or more, as the writer has for the past ten years, to show him the weak and strong points in oil-box covers and to convince him which is the best and cheapest.

MEMBER M. C. B. ASSOCIATION.

Alterations in the Allen Valve.

Editor National Car and Locomotive Builder:

In your journal for May you give some diagrams showing results that were got by alterations in the Allen valve. We in this part of the country (Western division of B. & O.) recognize the great abilities of the gentleman mentioned in connection with the article; but I think better results would have occurred by the cutting out of the inside lap and increasing the lead by advancing the eccentrics. I also think that greater improvement would have been found had the outside lap been cut down $\frac{1}{16}$-inch and the lead on piston been made $\frac{3}{32}$-inch, for then the engine would have been quicker. This is my experience after twenty-five years on locomotive work, although I have never seen the indicator used, nor am I an expert in reading diagrams. My belief is founded on the good results of our practice, and all engineers going over our road are surprised at the capacity of our 16 × 24 inch engine.

D. O. SMITH.

[We had suggested to Mr. Meehan the propriety of trying the effect of cutting out the inside lap and giving the valve a little clearance inside, and we believe that the change will improve the engines if tried. We are, however, of the opinion that cutting off part of the outside lap, as suggested by our correspondent, would be a mistake, and we think the short lap engines, that are such great favorites with enginemen all over the country, are ruinous to the companies using them. They are "smart" on starting, but they use a great deal of steam in doing work.—Ed.]

Need of a Link and Pin Standard Coupler.

ST. PAUL, May 23, 1889.

Editor National Car and Locomotive Builder:

I would like to suggest to the M. C. B. Association, through the columns of your valuable paper, the advisability and necessity of adopting a standard link and pin coupler. The association have already adopted a standard type of self-couplers, and what is needed now more than anything else is a standard non-automatic link and pin coupler to be used for repairs. It is impracticable to suppose that any railroad would replace a broken link and pin draw-bar with the present standard self-coupler, and if any other is substituted which is not a standard of the road owning the car, the result is a defect card must be attached to the car before a connecting road will receive it. This may not universally be the case, but it is in a great many instances. After the defect card is attached the car is allowed to proceed, and when the car arrives home or on its own road the draw-bar is removed and one of the standards of the road substituted, although the one removed may be every way as good a draw-bar as the one substituted, yet it is not standard, and the road owning the car have a right to make a bill against the road making the repairs and attaching the defect card.

There are also roads that have several patterns of draw-bars, all of which they call their standards. Now, suppose a car has two kinds of draw bars, both of which may be standards of the road owning the car. This car is received from that road by a connecting line, whose inspectors are familiar with the standards of the road without a defect card. It passes over the line, and is offered to another road whose inspectors, not being familiar with the various standards, will not receive it without a card for a wrong draw-bar, which is often attached and the car allowed to proceed, when it reaches some road which feels authorized to make the necessary change or repairs, and do so, making a bill against the company that attached the defect card. This, you will see, works an injustice to the road which received the car in good faith and also in good order.

If the M. C. B. Association will now adopt some good form of non-automatic link and pin coupler to be used for repairs, so that when a car arrives home after being repaired, the company owning the car will be obliged to accept it if the repairs have been properly made, they will be taking a long step in the right direction, and railroad companies will not be obliged to carry a large stock of various kinds of draw-bars at terminal or junction points for which they can only receive credit as so much scrap.

INSPECTOR.

A "New Device."

An Omaha paper, under the the caption of a "New Device," says: "Yesterday engine 717, standard freight, on the Union Pacific, went west with a heavily laden train of cars. This is the engine that has been equipped with a horse power indicator in order, if possible, to ascertain the quantity of coal required in handling a certain number of cars, or, in other words, in order that some basis may be obtained to regulate the quantity of coal actually required. The indicator rests on the steam chest of the boiler. This is a device of George Cushing, superintendent of motive power of the Union Pacific, who, just at present, is laying out plans for rigid economy. He is of the opinion that the firemen are wasting coal to a large extent by not firing their engines properly, and has devised this system of ascertaining the quantity required to move rapid and heavy trains."

It must be a little bit amusing to Mr. Cushing to be credited with the invention of the indicator, an instrument that is old as the time of Watt. The great pity is that the instrument is so little used on locomotives that even engineers look upon it as a novelty. We have no doubt but the officers of the Union Pacific will learn more about the working of their locomotives than they ever did before since they have resorted to the indicator as an aid to investigation.

The Manhattan Elevated Railroad Company have lately put men to work whose duty it is to be indicating locomotives all the time. A systematic record of the condition of steam distribution of each engine will thus be main tained.

A special dispatch from Washington states that one of the most important patents in connection with the construction of sleeping cars was lately issued to Mr. Louis J. Harris and Mr. Arthur W. Crossley, assignee. Both gentlemen belong in Boston, and are well known in railroad and patent circles. The patent is for an entirely new departure in the manner of constructing sleeping cars. By an ingenious arrangement of dropping the side frame-work of the car some 12 inches lower than usual a series of pockets are to be constructed under the floor of the car on each side of a center aisle. In each of these pockets are to be placed both berths of a section, leaving the interior of the car clear of any appearance of a sleeper and allowing its use during the day as a parlor car. At night sections of the floor are to be raised and fastened at right angles with both the floor and the side of the car, while, by an ingenious arrangement of gearing, the berths are run up out of the pockets into proper position, and the chairs placed in the now empty pockets. The principal weight, it will be seen, is kept near the bottom of the car. Each section can be made up entirely independent of the other, and by economizing space the berths are two inches longer and four inches wider than those of Pullman cars, while there will be eight inches more space between the lower and upper berths. Space is given under the center of the car for all brake rods, air and steam pipes.

At the Erie meeting of the American Society of Mechanical Engineers, Mr. F. W. Dean read a paper on the Distribution of Steam in the Strong Locomotive. Four indicator diagrams were submitted, most of them having been taken at a speed of about 200 revolutions per minute. The average steam consumption shown by the four diagrams is 21.6 pounds per horse-power per hour, a very good record.

The Boiler Feeding Injector.

Although the injector is not theoretically so efficient as a good pump, practically it has proved itself the best means of feeding water to locomotive boilers that has ever been tried. When a well made injector is used regularly, it is more reliable than any form of pump, is more easily examined and repaired when it gets out of order, is less liable to freeze or to sustain damage from accidental causes, and it regulates the quantity of water required as well as the ordinary pump, and better than any pump actuated by the machinery of the engine when the speed of a train is irregular. The injector also possesses the important advantage that it raises the temperature of the feed water to approach the temperature of the boiler, thereby avoiding shocks and strains to metal that very cold water is likely to impart.

PRINCIPLE OF THE INJECTOR'S ACTION.

Although the mechanism of the injector is very simple, the philosophy of its action is not so easily understood as the principles on which a pump raises water and forces it into the boiler. On beginning to investigate the action of the injector, it appears a physical paradox the finding that steam at a given pressure leaves a boiler, passes through certain tortuous and contracted passages, raises several check valves, and then forces water into the boiler against a pressure equal to that which the steam had when it began the operation. At first acquaintance, the operation looks as if it had a strong likeness to perpetual motion, but closer investigation will show that the steam which raises and forces the water by passing through an injector performs mechanical work as truly as the steam that pushes a piston which moves a pump plunger. A current of any kind, be it steam, air, water, or other matter, has a tendency to induce a movement in the same direction of any body that it comes in contact with. Thus, we are all familiar with the fact that a current of air called wind, passing over the surface of a body of water, sets waves in motion, and dashes the water high up on the shore away above its original level. In the same way, a jet of steam moving very rapidly, when injected into a body of water under favorable conditions, imparts a portion of its motion to the water, and starts it with momentum sufficient to overcome a pressure even higher than the original pressure of the steam. The locomotive blast, blowers, steam siphons, steam-jets, jet-exhausters, vacuum ejectors and argand burners are all common instances of the application of the principle of induced currents.

VELOCITY OF STEAM AND OF WATER.

At a boiler pressure of 140 pounds per square inch steam passes into the atmosphere with a velocity of 1,920 feet per second. When steam at this speed strikes like a lightning flash into the tubes of the injector, it becomes the ram which forces the water towards the boiler; but its power is opposed by the tendency of the water inside the boiler to escape through the check-valve. The velocity with which water will flow from a vessel is known to be equal in feet to the square root of the pressure multiplied by 12.19. Accordingly, in the case under consideration, the water inside of the boiler would tend to escape at a speed of 144 feet per second. This represents the resistance at the check valve. The mechanical problem, then, to be worked out by the injector is to transform the energy of hot steam moving at a high velocity into the momentum possessed by a heavier and colder mass of water. In the operation the steam yields up a portion of its heat and the greater part of its velocity, but it keeps a current of water flowing fast enough to overcome the static resistance at the check-valve.

TEMPERATURE OF INJECTED WATER.

A common delivery temperature of the water forced through an injector is 160 degrees Fah. Taking the feed water at 55 degrees Fah., we find that the steam used in operating the injector imparts 105 degrees Fah. to the feed water before putting it into the boiler. One pound of steam at 140 pounds boiler pressure contains 1,224 heat units reckoned above zero. When the hot steam speeding at a high velocity strikes the feed water, part of the heat is converted into the mechanical work required to put the water in motion; but there still is left heat sufficient to raise about 11 pounds of water to the temperature of 160 degrees. One pound of steam, therefore, communicates to 11 pounds of water the motion required for overcoming the resistance encountered at the check valve The steam moving at a speed of 1,920 feet per second having imparted motion to a body eleven times its own weight, itself in the meantime having become a portion of the mass, the velocity of the feed water would be $1,920 \div 12 = 170$ feet per second. When the reduction of speed due to friction of the pipes and other resistances is considered, there still remains momentum enough in the water to raise the check valve.

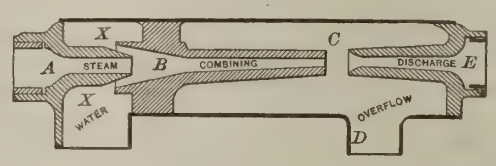
Although 160 degrees is about the average heat of the water delivered by lifting injectors, instruments can be designed so that they will heat the water much higher. When this is done, the speed of the feed water is proportionately greater than with the lower temperature. With non-lifting injectors, the feed water is nearly always delivered at a higher temperature than with the other kind.

ELEMENTARY FORM OF INJECTOR.

There are numerous forms of injectors in use, but they are all developments of the elementary arrangement of parts shown in the annexed figure. Steam at a high velocity passes from the boiler into the tube A, and striking the feed water at B is itself condensed, but imparts momentum to the water to send it rushing along into the delivery pipe E with sufficient force to raise the check valve against the pressure inside and pass into the boiler. As the current of water could not be started into rapid motion against the constant pressure of the check-valve, an overflow opening is provided in the injector, through which the water can flow unchecked till the necessary momentum is obtained, when the overflow valve is closed.

In a lifting injector, the parts are so designed that in starting, a jet of steam passes through the combining tube B at sufficient velocity to create a vacuum in the water chamber $x\,x$, and the water is drawn into this place from the feed pipe as if by the suction of a pump. The steam jet then striking the water starts it into motion. If too much steam is admitted for the quantity of water passing, air will be drawn in through the overflow opening mixing with the water and reducing its compactness, while some uncondensed steam will pass through with the water. This will reduce the force of impact of the feed water upon the boiler check, and when it becomes so light that the momentum of the feed water is no greater than the resistance inside the boiler, the injector will break. On the other hand, when the quantity of water supplied is too great for the steam to put into high motion, part will escape through the overflow valve. In some forms of injectors separate appliances are used for raising the water from the source of supply to the forcing chamber.

As the successful operating of the injector is dependent on the feed water promptly condensing the steam which supplies the power, water of a very high temperature cannot be fed by an injector. A certain amount of live



steam must be condensed by the feed water to impart the momentum necessary to make the latter overcome the resistance at the check valve. When the feed water becomes hotter than 100 degrees Fah., a point is soon reached where it takes such a large body of water to condense the steam that there is not the required velocity generated to force the feed water into the boiler.

All deviations from the elementary form of injector shown are made for the purpose of extending the action of the instrument under varied conditions, for making it work automatically under different pressures of steam, and for increasing its capacity for raising the water to be used above its natural level.

Advantage of a Full Throttle.

A correspondent of the *Locomotive Engineer*, having expressed himself in favor of the practice of running locomotives with a partly closed throttle, "Grant," hailing from Dayton, O., takes the other side in the following highly sensible remarks:

Now, I do not wish to be impertinent, but, thanks to Mr. Sinclair and Mr. Forney, and the growing number of men who carry their theories into such successful practice, we firemen are beginning to look with disgust at the man who throttles his steam, because we know it means work.

Every one knows that there is a class of engines—which, luckily, are disappearing—that cannot be worked full throttle. Such a class are those engines of former days—the little engines with small boilers, small nozzles and steam ports. But take the modern locomotive with its 50-inch boiler, 4¼-inch single nozzle and large steam ports, and I think many older men will agree with me that full throttle is the best.

Let me give an instance. Probably the best freight runner on a certain railroad was an engineer we will call Will. I fired for him once for a short while, and learned why. The freight engines were eight-wheel, 17-inch cylinders. Over a 60-mile division our summer trains were 36 loads of bulk and 40 loads of merchandise freight. There are two water tanks, the last being 15 miles from the end of division. During the time I fired for him he never stopped at the second tank for water, and never was the coal-gate taken out going north (we burned slack coming south). His was the only engine that did it, as a usual thing.

How did he do it?

After the first few exhausts the engine was cut back to half stroke, full throttle; in a train length to one-third stroke, and after that, where possible, to 6-inch cut-off. When he wanted to kill time, back she went to 4-inch, and only when the engine was doing more work than was necessary there did he partly shut off the throttle. He rarely carried more than three scant gauges of water, and this to me seems to be the secret of the expansive use of steam—the use of dry steam.

This man could work injectors where others could not, because he had read their description and understood their principle. Although one of the youngest engineers, he was chosen to run as through passenger runner, because, as the superintendent said, "He has never failed to do what we have told him to do."

I never noticed that his engine rode harder than others worked differently, and I generally had steam. When we came to a side-track he would shut off his guide-cups. As a result of this and other care, he ran 120 miles to four pints of engine oil when eight pints were allowed. His engine never ran hot, and he never stole any oil to do it with.

On this same division, within the past year, four firemen have been promoted. Two are doing good work and two are on extra list. The first two are full throttle men, and the last two are not. Another runner on this same road won't work his engine "high up," because it might wear the valves "spoon-shaped."

When I began to fire for our friend Will I was a beginner. I thought all that was necessary was plenty of smoke. I soon learned that smoke was an abomination to him, and so also was "popping." I saw the reasonableness of it, and tried to prevent them, succeeding in the end pretty well. But I have since learned that a fireman cannot do this unaided.

I do not deny that some of the most successful runners on many roads are men with John Alexander's ideas, but take runs where you have to scheme for water and coal as well as to make fast time, I am skeptical as to their ability to compare with my man. When railroad officials want a fast run made, they rarely figure on the capacity of the tank, or the distance between water tanks. They expect the engineer to do that.

The Lumber Trade and Freight Rates.

Railroad companies are likely to be substantial gainers from the stability of freight rates due to the agreement of general managers and to the amendments of the Interstate Commerce Law, but there are indications that the higher rates will be prejudicial to certain established interests. The *Northwestern Lumberman* takes a very gloomy view of the effect that stable rates will have upon the great lumber yards of Chicago. Our contemporary believes that putting an end to the system of special rates and rebates will have the effect of depriving Chicago yards of a large volume of trans-Missouri business; and that it will be impossible for the large dealers to keep in stock the immense supply of lumber hitherto carried. An able article on the subject concludes as follows:

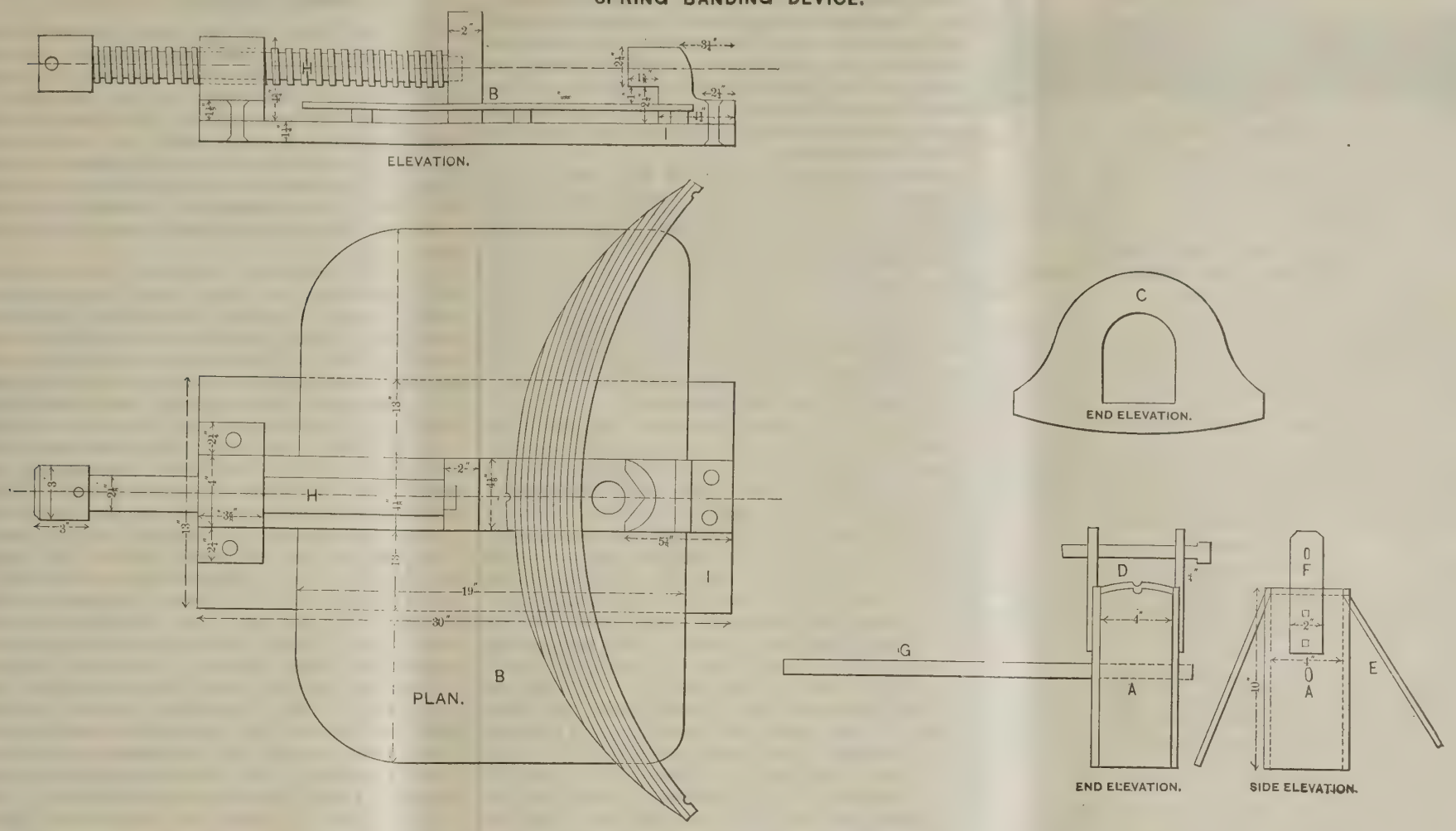
It is probable that the wholesale yard trade of this city will hereafter have to be conducted on a different plan than heretofore. Stocks will have to be adjusted to the more recent requirement, which is increasingly local and near-by. Dealers must make up their minds to conduct their business in a more conservative way than formerly, and depend less on the heavy shipping demand. There is no longer need of tremendous stocks. They should hereafter be smaller, while particular care should be taken to assort so as to meet a variety of trade in the city and country. There will always be a wholesale demand, but it will be for special factory stock and for a scattering trade. Resort will be had to the yards here when dry lumber is wanted, and for sorts that cannot be had quickly elsewhere. But such a trade will never keep the mammoth yards going as they have been run heretofore. It is probable that the heavy shippers have already arrived at this conclusion, and that this year they will purchase stock with particular reference to the changed order of things. We can look for a gradual toning down of the high pressure wholesale business that has prevailed here, and a substitution therefor of a mixed city and general trade of a conservative character.

Large Mass of Passengers Moved Safely.

During the three centennial days the New York Elevated Railroad companies carried 2,356,117 passengers, the highest number for one day being 835,721 persons. This enormous mass of humanity was nearly all carried in eight hours, as business was unusually light except during the hours when the mass of sightseers were going down or up town. The great business was done with very little delay and the punctuality of the trains was in striking contrast with the blockades that happened on some of the surface roads running into New York. One small block was caused by the slow manner in which the military companies from Delaware filled a special train provided to take them from 9th street to Hanover Square. The officer in command persisted in having the men move into each car single file by a single gate, and when the trainmaster remonstrated, the pompous martinet turned away and would not be spoken to. The train was thirteen minutes in loading the troops, when the proper time was three minutes, and it caused a block of trains a mile long. The Elevated railroad people find that they can handle a crowd of New York people much prompter than when an unusual percentage of country people have to be carried. New York people lose no time in boarding and getting out of trains, but those not accustomed to fifteen-second stops act as if it was of no consequence how long it takes them to get on and off trains.

The number of passengers carried on the busiest day would fill 13,928 cars, reckoning 60 persons for a car. If this number of cars were set in line they would make a train 111 miles long. Estimating 700,000 to have been carried in eight hours, over 1,400 persons must have gone on and off the trains every minute.

SPRING BANDING DEVICE.



The annexed engravings illustrate a very cheap and convenient method of making bands and of banding springs, in use on the Central Iowa, and designed by Mr. Charles A. Miller, foreman of the blacksmith shop of the mechanical headquarters, at Marshalltown, Ia.

The casting *A* is planed on each side, leaving a breadth corresponding with the width of spring steel used. It is also planed on top the exact shape required for bottom of band, to fit a plain or spool saddle. The former, together with the bar of heated iron intended for band, is placed under the steam hammer with a steel block, conforming to shape of bottom of band, and about 1¼ inches thick, is placed on top and between lugs and still another block to prevent hammer from striking lugs. Then two or three hammer blows will complete this part of the operation. Then the last block is removed and a key driven over the first block, which will hold all firm, while the ends are lopped down and former turned on either side to receive a few more hammer blows. The band is now complete, and has occupied about one minute of time, and when holes are punched to receive bolt through band and casting on top of spring, occupying about another minute, the band is ready for spring.

The leaves that will compose the spring are now placed on edge on table *B* and against block *C*, which is of a width to correspond with width of spring steel used. The band, being open at the top, can now be placed in position, as the groove in table will permit one side of band to slide under the spring leaves, and with a few turns of the screw the pin or bolt can be passed through the band and casting *C*. A split key prevents the bolt being lost, and is very convenient to remove when repairs are necessary.

This last operation of banding a spring is performed within two minutes by the spring maker and one helper.

George Westinghouse, Jr.

George Westinghouse, Jr., president of the Westinghouse Machine Company and many other corporations, was born at Central Bridge, Schoharie County, N. Y., Oct. 6, 1846. Throughout his entire life he has shown a marked mechanical bent, and his mind has constantly run on inventions the object of which was to do by machinery what had previously been done by hand.

His father owned and operated a large works at Schenectady, N. Y., for the manufacture of agricultural implements, and he showed his good sense in giving his boys (as a part of their education) practical instructions in mechanics.

George, in early days, was very fond of playing ball, and sometimes his father, on returning to the works, would find the lad absent, for obvious reasons. These absences led to interviews. At last it was decided that George's work should be arranged on the piece system, instead of on the time system. In other words, his task was thenceforth to consist of a given amount of work each day, which he might expedite as much as he pleased, and, after it was done, he was at liberty to repair to the ball grounds. Here was an opportunity for invention, and the lad did not fail to utilize it. Without any previous knowledge of the now well-known disk method of cutting metals, he experimented and soon discovered that, with a circular disk of soft sheet iron, on the highest speed of his lathe, he could split a file. He quickly utilized this method of completing his daily task and repaired so early each day to the ball grounds, that his father at first feared a miscount had occurred. On watching George at work, however, he soon saw, with his own eyes, how the remarkable feat was accomplished.

Steam engines of various types early attracted the boy's attention, and he designed and built a number of these.

He also invented a reversible steel railroad frog, which was manufactured twenty years ago by the old firm of Anderson, Cook & Co., Steel Manufacturers, of Pittsburgh, on a royalty, and George was employed to introduce it.

While at Schenectady he once saw a crude attempt made to retard a railroad train by steam power on the New York Central Railroad. It was, however, a dismal failure, because steam condensed so rapidly that power was not furnished, but water.

After moving to Pittsburgh, and while constantly conferring with railroad officers regarding his steel frog, he became more and more impressed with the necessity for a good continuous brake. Many railroad officers admitted to him, at this time, the necessity for such a device. He then devoted his evenings to the development of his now celebrated air brake, and he selected air as the power medium, because it was cheap, light, elastic, would not condense, and was to be had at will, wherever a train could move.

Mr. Westinghouse has devoted deep study to electrical engineering—more particularly as applied to lighting—and his improvements in this field are already well known.

He has also devoted much thought to the utilization of nature's bounteous supply of natural gas, in the vicinity of Pittsburgh. While this fuel has now, through his efforts, almost superseded coal for both manufacturing and domestic uses in the city of Pittsburgh, few persons realize the number of intricate and perplexing problems which presented themselves in conducting this fuel a distance of twenty-five miles to the consumers, with safety and unfailing regularity. The number of inventions he has made, to render this feat possible and safe, may be counted by the hundreds. The development and successful operation of the great plant of the Philadelphia, or Westinghouse, Natural Gas Company has given Pittsburgh such a supremacy in manufacturing, as to lead less favored districts to inquire what they may do to improve their condition. This company now has on its list about 30,000 consumers, who use the equivalent of 20,000 tons of coal daily.

Freight Car Trucks.

At the May meeting of the Northwestern Railway Club, Mr. W. T. Reed, St. Paul & Kansas City Railway, read the following paper:

Regarding trucks for freight cars. Possibly each road at the present time has its standards, which it considers suitable. Such is reasonable, when we must know that what suits one road is not adapted to others. For example: If a road is comparatively straight, rigid trucks would, I consider, be in place, but where roads are otherwise, such as we have in this Western country, where speed and curvature are to be provided for, lateral motion is, I think, necessary; and for the following reasons: (1.) Side motion provides to a great extent against sudden pressure being brought to bear against the outer rail on curves and other contingencies in track which present themselves after heavy rains. (2.) There is reduced pressure against flanges of cast wheels, which is an important feature with us when the temperature is low through the winter months. (3.) There is obtained easier lateral motion to body of car, and hence less shaking up of stock and other important freight. (4.) It has been found necessary to have easy side or lateral motion on passenger coaches, which is provided for in the truck; and what is good for the passenger coach must necessarily be applicable to the freight car.

While among the many classes of car trucks opinion regarding lateral motion and rigid trucks is somewhat divided, and no particular standard has yet been thought of, I believe in lateral motion, if such could be obtained practicably, dispensing altogether with spring board and hangers. The fewer parts there are in connection with car trucks, the lesser we have to shake loose and to maintain. One of the main features in connection with trucks is the arch bars. It has been found in practice that between 60 inch axle centers, arch bar spread about 17 inches was adequate to carry the 60,000-pound car, top bar being 3 by 1¼, second bar 3 by 1, and bottom bar 3 by ¾; arch bar bolts 1⅛, with fillet under head and secured by two nuts on bottom; oil box bolts one inch and also secured by check nuts, with truck sides 12 by 5. The above proportions are quite capable of carrying a 40,000 or 60,000-pound car, whichever way bolster be arranged for, namely, lateral motion or rigid. Wheels for cars of the above-mentioned capacity should not run less than 600 pounds to the wheel.

While due consideration has been paid to truck frame, wheels and axles are of the greatest importance. In regard to axles I would strongly recommend that the centres of journals still remain according to Master Car-Builders' standard, namely, 6 feet 3 inches, and the diameter of journals be increased to 4⅛ by 7 inches. It is not at all desirable, I think, to increase the leverage between tread and center of journals, the closer the weight can be kept to the center of tread the less chances there are for sprung journals. Large fillets should also be provided at inner parts of journals. It is at this point that we find axles generally sprung. I would recommend that wheel seat on axle be increased to 5⅛ from 4⅞, with center of axle 4⅝. Good scrap axles I have always found to give better results than that of muck iron or faggoted. Many companies prefer making their own axles and can place more dependence in same knowing from what scrap they are made.

Regarding brasses for oil-boxes, we have used the brass casing one-half inch thick at crown, filled with Randolph metal, which has given general satisfaction. I would recommend that oil-box covers be of the drop-lid style of sheet steel. Considerable trouble has been experienced in regard to obtaining good tight covers. The drop steel cover has two features; in the first place it is light and will not break, and secondly, it will adapt itself to the outer face of box by pressure from spring.

In regard to tender trucks: Many have found it judicious to locate weight on front truck entirely center bearing and on rear truck side and center bearing, and especially where side bearers are spread so that spring stands directly over arch bars. The idea is to prevent as much as possible the surging of water in tank. The outer elliptic spring on rear truck taking care of the rocking motion it would necessarily follow that a tank would ride steadier, especially when trucks are close together as against trucks a distance apart. I have found fewer tank trucks of this type leave the rail on rough track than any other. Friction or stop blocks should be arranged for with sufficient clearance, and so as to be of service in case of a broken spring. Elliptic springs are preferable to spiral for tender trucks. For a tender having a tank of 3,000 gallons capacity I would recommend the same size journal and axles as for freight cars, as above mentioned. Also, I would recommend steel tired wheels for tender-tank trucks of locomotives used in passenger service.

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EDITORIAL ANNOUNCEMENTS.

Advertisements.—*Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING COLUMNS. *The editorial department will contain our own views and opinions; and the rest of the reading matter, aside from advertisements, will be such as we consider of interest to our readers.*

Contributions.—*Articles relating to railway rolling stock construction and management, and kindred topics, by those who are practically acquainted with these subjects, are especially desired. Also early notices of changes in railroad officers, organizations and names of companies.*

Special Notice.—*As the* CAR AND LOCOMOTIVE BUILDER *is printed and ready for mailing on the last day of the month, advertisements, correspondence, etc., intended for insertion, must be received not later than the 25th day of each month.*

Power of Compound Locomotives.

We have got into a curious dispute—it cannot be called controversy—with some of our contemporaries about the merits of compound locomotives. At the April meeting of the New England Railroad Club, the editor of the NATIONAL CAR AND LOCOMOTIVE BUILDER read a paper on "Compound Locomotives." Considerable experience with compound engines in marine service, and an interested and careful study of the construction and performance of compound locomotives ever since they were first put into service, influenced the author of the paper referred to in favor of compound locomotives receiving a fair trial on our railroads. It appeared to him that in Europe, in Asia and in South America the compound locomotive had performed economical service, and that there was no reason why a motor modified to meet the conditions of our train service should not give us motive power at reduced cost. He was convinced, however, that on many of our roads the simple engine was not worked at nearly its maximum degree of economy, and that there was no use in such roads trying the compound. It appeared also certain, that any existing form of compound, nearly all of which use the steam expansively after the first revolution, could not handle American trains as they must be handled, for nothing short of the starting power common to simple engines would meet the demands of our train service. We could not see how an engine using the steam expansively could exert the same power as an engine of the same cylinder capacity that used steam chest pressure throughout the whole stroke.

We were aware that the compound locomotives designed by Mr. A. Mallet for the Bayonne & Biarritz Railway have appliances which permit the engines to be worked without compounding at the will of the engineman, but the locomotives are small and limited in number.

At the conclusion of the reading of the paper containing these points somewhat elaborated, a young man present, who evidently came prepared to assail the paper, fired off a volley of criticisms and objections, principally compiled from foreign journals, most of which missed the intended mark because it was not there. But that did not prevent the critic from sending substantially the same stuff as editorials to the *Railroad Gazette* and other papers. It was made to appear that the NATIONAL CAR AND LOCOMOTIVE BUILDER and its editor were dangerous enemies of the compound locomotive, and our contemporaries zealously came to the rescue as defenders. Later on they have settled down to elaborately repeating the assertion that the compound locomotive is as powerful in starting a train as a simple engine is—or at least it can be made as powerful. (We had said that the problem to be worked out by the American designer was to make the compound as powerful as a simple locomotive in starting.) A curious proof is given to show that the compound is as powerful as a simple engine. Two locomotives are taken, one with high pressure cylinder 18 inches diameter and a low pressure cylinder of the usual proportion, and a simple engine with two cylinders 18 inches diameter. The total pressure on both pistons of the compound is figured to be 60,845 pounds, and the total pressure on the cylinders of the simple engine is calculated to be 73,440 pounds. There, says the mathematician of the *Gazette*, both these engines have the same weight on the drivers, are they not of equal power in starting? The simple engine is admitted to be capable of utilizing 90 per cent. of the boiler pressure in starting a train, "provided it is possible to use full boiler pressure in the cylinders and not slip the wheels." This writer evidently thinks that the throttle of ordinary American engines cannot be opened full when the links are in full gear without the wheels beginning to slip. It is rather an amusing statement to be made in a paper like the *Gazette*. We are then informed:

"When it is remembered that the limit to the increase of power of any particular design of locomotive lies in the increase of weight, and that the diameter of the cylinders can be made as large as desired without interfering with the essential features of the design; and when it is further remembered, that there is no obstacle in the way of an increase of cylinder power, while retaining the same total weight, in the case of the double expansion (compound) any more than there is in the case of the single expansion locomotive, it is clearly seen that all the discussion about the inherent evils existing in the double expansion locomotive which render it unequal to the demands of the suburban and heavy train service is as useless as it is uninteresting when the facts are known."

Every engineer knows that the final measure of the power of all locomotives is the weight resting on the driving wheels; but the writer of the above paragraph does not appear to realize that there are as serious objections to the over cylindering of a compound locomotive as there are to making the same mistake with engines of common design. The cylinders of all well-proportioned simple locomotives are made of sufficient capacity to utilize nearly the whole weight on the drivers in starting or during a heavy pull, without slipping the wheels on a dry rail. A serious drawback resulting from this practice is, that the cylinders are very often too large for economical working when the engine is doing the light work necessary to keep a train running on a level track. To make the engine capable of doing the work necessary during 20 per cent. of her daily performance, the cylinders have to be made too large for the economical performance of the work called for during the remaining 80 per cent. of the day. Attempts have frequently been made to make use of an abnormally large cylinder as a means of increasing the ratio of expansion, but they never failed to cause loss of fuel. There is no reason to suppose that the evil effect would be any less in giving a compound locomotive abnormally large cylinders.

As the *Railroad Gazette* has been shouting very loud lately, to put us in the wrong and convince people that existing compound locomotives are as powerful in starting as simple engines of like cylinder capacity, we will take the liberty of quoting some views of the same journal, published when a writer was on the staff who was well informed on the subject of locomotives. In "Recent Locomotives," page 106, there is an excellent article on Compound Locomotives, where we find the statement:

"After the first complete cycle of operations, no increase of power is gained by admitting steam from the boiler to the low-pressure cylinder and the engine must work compound. This implies that after the first cycle of operations—which cannot consume more than one revolution—the engine is incapable of working with less than nearly a threefold expansion—equivalent to about 9-in. cut-off. The average pressure on the piston obtainable in a locomotive working with 12-in., 15-in. and 18-in. cut-offs cannot, therefore, be obtained in this type of compound locomotive. As the maximum average pressure is lower than in ordinary locomotives, it is evidently difficult to compare them with ordinary locomotives by the size of cylinder. A compound that would exert as much power as an ordinary engine at high speed, when the cut-off cannot be more than 10-in. would not be able to do the work of the ordinary locomotive, when climbing a steep grade, with a 12-in. or 15-in. cut off."

In the *Gazette* of Oct. 15, 1886, a Von Borries compound locomotive is illustrated and described. In the description we find the following:

"The tractive force of the engine when working compound is considerably less than is usual in express engines of similar weight here. The tractive power at the moment of starting is high; but as this power cannot exist after the receiver is full of exhaust steam at a high pressure, the engine cannot exert any tractive pull for any distance. Therefore, any heavy incline must be mounted with the engine working compound. When the engine is working compound in the full-gear notch, the equivalent total degree of expansion is about 1 : 2.7, equivalent to a cut-off in a simple engine of about 37 per cent. With the high boiler pressure used, it is possible that even with this comparatively considerable degree of expansion, an average pressure of 100 pounds per square inch might be obtained in the cylinders. The gross maximum tractive power of the engine, therefore, when working compound would be:

$$85 \times 100 = 8{,}500 \text{ pounds.}$$

"This is not a large amount for a coupled engine. The Chicago, Burlington & Quincy engine (18 × 24, 69 in. driving wheels), has a tractive force per pound average cylinder pressure of 114 pounds, and could easily maintain an average pressure of 110 pounds per square inch on the pistons. Under these circumstances the maximum tractive power when mounting a long grade would be about:

$$114 \times 110 = 12{,}540 \text{ pounds.}$$

"This is 45 per cent. in excess of the power that the compound would exert under similar circumstances, and shows that this type of compound is not suitable for a line in which there are any steep grades."

In our last issue we mildly suggested that the writers in our contemporaries should try to digest the mass of foreign literature they were giving to their readers about compound locomotives in order to make it adapted to American practice. The advice was not taken very kindly, but we believe that the back pages of the *Gazette* will supply ample proof that the advice was badly needed.

The Master Mechanics' Convention.

The members of the American Railway Master Mechanics' Association have this year again deviated from their usual custom, and decided to hold their annual convention in a summer resort instead of in a city, and they will meet at Niagara Falls on June 18. The prospects of a profitable and pleasant meeting are highly encouraging. The correspondence we have seen about accommodation at the hotel indicates that the meeting will be exceptionally well attended; and the business to be transacted promises to make the convention as valuable as any that have preceded it.

An unusually long list of subjects are under investigation by committees and several highly valuable reports may be expected. There has not been many circulars of inquiry issued by the committees; but we understand that this will not result in less comprehensive reports, as the members of committees are said to be making great efforts to obtain data from original sources, from experiments, also by private investigations. At present writing, in the last week of May, several of the reports have reached the secretary, and all of them are exceptionally well prepared, the information presented being in clear, succinct form. The growls of the last two conventions of reports being made up of indigested material appear to be bringing about a needed reform. The great diversity of appliances which railway master mechanics have to supervise, and the expensive machinery which they must labor to keep in the most efficient and improved forms, will always give the members of the American Railway Master Mechanics' Association sufficient subjects for discussion at each returning convention; and it is very desirable that the members of committees should realize that it is their duty to present the conclusions on subjects assigned to them for investigation in as succinct a form as possible. Of late years the topical discussions have proved a very interesting and valuable feature of the conventions, and we have no doubt that they will be as well kept up at the Niagara convention as they were at Alexandria Bay and St. Paul.

The establishing of standards for the parts of motive power machinery is not so urgent or necessary as it is for freight cars which wander all over this continent, but considerably more might be done with advantage in this direction for locomotives. The advantage of making as many parts as possible to standard forms and dimensions would lie in the reduction in the cost of manufacture that would result. The tendency of the day, in the making of all lines of machinery, is to divide parts up and make them by special machinery. There is no reason why the practice should not be developed more in locomotive building, and the establishing of standard shapes and sizes would be the best way to encourage this means of reducing cost. We already have, without recognizing it, standard interchangeable injectors, safety valves, cylinder lubricators and brake fittings. There is no reason why all kinds of wheel centers, cylinders, pistons, crossheads, guides, springs and their connections, engine trucks, tender trucks and other parts should not be bought ready fitted up. If this were done the parts would be made by special machinery at a low cost, they could be got ready for application without delay, reducing the time lost by engines undergoing repairs, and the system would permit a railroad to be operated with much less idle machinery than is now necessary.

The Railway Master Mechanics' Association has a membership of nearly 350, and by the nature of the system on which most of them reach their positions, a large proportion of the membership is composed of men well advanced in years. They have enjoyed a singular immunity from mortality this year, for only one member is reported to have died since last convention.

Something ought to be done at the coming convention to have the association incorporated under the laws of some state. Although the association has no legal existence, it possesses a fund of over $6,000, and the safe custody of this money is entirely dependent on the honesty of the member having it in charge. This is not a sensible way of doing business. If the organization was incorporated, the fund could be invested for the association and held as securely as property belonging to other companies and societies.

The Master Car-Builders' Convention.

For several years past there has been some subject of commanding importance awaiting for action by the Master Car-Builders' Association that made the annual convention to be looked forward to with inspired interest; but the coming convention, which opens at Saratoga on June 25, has little other than the ordinary run of business to make it attractive. There is still plenty of work to do in the line of extending standards and establishing improved forms, and it is to be hoped that a spirit of liberality will pervade the convention, and that members will display a willingness to move from the strict lines of their convictions or prejudices in order that agreement may be reached with others who entertain views that conflict on non-essentials. It appears to us that the most important matter that will be brought before the convention, is the selecting of a standard axle for a 60,000-pound car. This has twice been sent to letter ballot and as often

defeated, yet it is becoming very urgent that a settlement should be reached without delay about the dimensions of a heavy axle, but it will require more forbearance than was manifested last year if an acceptable standard is sent to letter ballot. There is fear that the contending interests will split on the rock of requiring the new axle to be the same length between centers as the existing standard axle. In 1887 a heavy axle was sent to letter ballot which made the distance between centers 6 feet 4¼ inches, 1¼ inches more than the existing standard. Although this axle was defeated in letter ballot, its dimensions proved acceptable to most of the railroad companies that were making heavy axles, and a great many axles of this size have been put into service. It looks as if the contending forces on the axle question in the coming convention will be arrayed with the men who have got in use heavy axles of the 1887 form on one side, and those who have no large axles in use, but insist on the new standard being 6 feet 3 inches between centers on the other. To an onlooker it appears as if the abstract in the case ought to yield to the concrete.

Of almost equal importance to the question of a new standard axle is the report on Car Heating and Lighting, as the committee having the subject in charge are requested to select a steam pipe coupler to be submitted to letter ballot. If the committee or the convention come to an agreement on this subject it will be something worthy of commendation.

Our correspondence pages bear testimony to the fact that there is considerable interest in the forthcoming report on journal-box lids, but the probabilities that a selection will be made and submitted to letter ballot are very remote. There ought, however, to be no great difficulty in agreeing upon "Standard brake gear for air brake cars, with a brake shoe for iron beam," and we may rest assured that Mr. E. B. Wall, the chairman of the committee, will make the best of the arguments to be advanced in support of his recommendations.

There ought not, and there will not likely be, much opposition to sending to letter ballot the recommendations of the committee on "Buffers and Carrier Irons for the Master Car-Builders' Type of Coupler and a Standard Length of Draw-Bars." At last convention, through press of other business, the admirable report on "Wheels" received little consideration, and the committee was continued with instructions "to ascertain from the members of the Association whether the recommendations of their report would be acceptable to them, and from the replies received, and the further experience which they may get during the coming year to formulate a report with recommendations, which can be submitted to the next meeting of the Association for letter ballot, their recommendations to be adopted as a standard if they meet the approval of the Association." As the recommendations of the orignal report passed the Master Mechanics' Association without a dissenting voice, the committee, even after a year more of labor under very recondite instructions, are not likely to report anything liable to prevent the adoption of the first report, and the recommendations certainly ought to be sent to letter ballot without much talk.

The remaining subjects for discussion are reports of a committee "To Formulate a Code of Rules for the interchange of passenger cars, including sleeping, parlor, chair, baggage and express cars," and of a committee on "Journal Lubrication and Best Practice for Economizing Oil." There is amply sufficient important business to make a very profitable and interesting meeting.

Reforms on the Baltimore & Ohio.

There is said to be great excitement in Baltimore respecting the decision of the Baltimore & Ohio Railroad's new management, to put an end to the practice of building new locomotives and cars in the Mount Clare shops. It is understood that this change of policy will lead to a great reduction of the working force in the shops, and that consequently it will inflict hardship and injury upon tradesmen, property owners and others in the city of Baltimore. This is no doubt to some extent true, and if the management of the Baltimore & Ohio Railroad Company were more interested in the welfare of the city of Baltimore, and less concerned in the prosperity and economical operation of the railroad they have charge of, it would be wise and prudent to continue the past policy which appeared to make the interests of the company subservient and second to the interests of the city. Under this policy, Mount Clare shops, which are in the city of Baltimore, grew up into a huge manufacturing establishment where all the plant and machinery required for the use and operation of the road was supposed to be fabricated much of it from the raw material. The manufacturing plant originally put in soon became inferior to that which parties making a specialty of producing in a particular line were using, and the specialist could do the work better and sell it cheaper than the railroad company were able to make it. But the pride of "doing our own work" and the interests of the city of Baltimore induced the various past managements to continue making bridges, and frogs, and signals, and locomotives, and cars, and a great many other things which could be bought cheaper and better from the outside makers, who, stimulated by competition, have been constantly striving to improve their designs, material and methods of manufacture.

We believe it is safe to assert that the railroad companies which have been and are able to use the greatest proportion of the income earned for the purpose of paying interest, taxes and dividends, are those that have followed strictly the business of transporting freight and passengers and have left the business of manufacturing railway appliances to those who make that line of production a specialty. It is necessary for most railroad companies to maintain shops for the repair of plant; but the more rigidly such establishments are confined to a narrow line of operations, the better it is for the interests of the company. It is often necessary to prevent expensive fluctuations of work in a repair shop to keep the construction of a few new locomotives or new cars going on; but the company that undertakes to do the building of all new rolling stock for themselves in competition with manufacturers always pay dear for their enterprise. In no country have subdivision of manufacturing operations and the employment of special methods and special tools for the cheapening of production been carried to the same perfection as they have been brought to in America. The wise users of machinery are those who buy from those who have given their whole attention to the art of producing well-made goods at the least possible cost. To put themselves in line with modern ideas and methods, the Baltimore & Ohio management ought to close out entirely the bridge building at the Mount Clare shops, stop the building of locomotives and cars except what would be necessary to keep tools at work when repairing is slack, and put in a thoroughly organized plant with shops adapted for doing repairs economically. Through a short-sighted idea of economy, it has been the policy of the company to hold on to ancient machinery as long as it could be operated. The road will never be operated at ordinary cost till a great many cars and locomotives have been turned into the scrap heap and replaced by those of modern design, and a large percentage of the machine tools sent to the cupola. A reform of this kind will have to be effected before the company is placed on a sound financial basis. The longer it is delayed the worse it will be for those interested in the prosperity of the property.

Discussing Rules of Interchange of Cars.

It will be fortunate if the lion's share of the time available at the Saratoga Convention is not wasted on fruitless reiteration of talk about the Rules of Interchange of Cars. We are very strongly of the opinion that the best thing that could be done with the rules in question would be to let them alone for a year or two, so that inspectors might get time to become acquainted with them. The Arbitration Committee recommended that the various railroad clubs should discuss the rules of interchange and try to agree upon changes to be recommended. The move was a very wise one, but it developed such hopeless diversity of opinion about trifles that we see no probability of the meeting that will convene to discuss the rules profiting any by what has been done. The Rules of Interchange as they now are framed give substantial justice to all interested in the interchange of cars. One cannot read particulars of the disputes about the interchange of cars without being convinced that some parties are constantly trying to interpret the rules with a view of taking advantage of their connecting roads, and it is impossible to frame rules that these parties will not pretend to misunderstand. Complaints are made that the car inspectors do not understand the rules, but the practice of changing them is the very way to give excuses for wrong interpretation of plain words. If many of the master car-builders would take a little of the time they use denouncing the rules of interchange to explaining the obvious understanding of them to inspectors, there would be fewer causes of complaints.

The greater part of the difficulties that arise in the interchange of cars happen on roads where inspection is carelessly conducted, and the complaints of the parties concerned are worthy of little consideration. Owing to careless inspection, a defective car passes on to say the D. E. & F. road without the defects being detected. When the car reaches the G. H. & J. yards, the next connecting line, the inspector discovers that the car has say a broken sill, and refuses to accept it without a card. The D. E. & F. people protest that the defect is old, and they put on a card only to prevent the car being delayed and instantly set about trying to hold the A. B. & C. line from which they accepted the car or the owner responsible for the defect, and all sorts of attempts will be made to controvert the interchange rules to try and make out that the parties at fault are acting legally. The inducement to crooked action of this kind is what results from the impairing of the efficiency of the car inspecting force alluded to by our correspondent J. C., who is a car inspector at an important point. Another unscrupulous way of making up for loose inspection is that mentioned by "Minneapolis Inspector" in another column, which consists of bullying connecting roads into giving release cards for imaginary defects. People who act in this way have no respect for any rules, and it is useless for master car-builders to waste their time trying to frame regulations that cannot be violated. The history of legislation has abundantly proved that nothing can be composed plain enough to be beyond misconstruction by those who are anxious to distort its meaning. Those who are laboring to make the Interchange Rules so plain that there shall be no loop hole for misinterpretation are working on an impracticable idea.

Present Standing of the Car Coupler Question.

The long letter in our last issue on "The Car Coupler Question," signed "New England," has brought upon us a flood of letters from parties interested in link and pin patent couplers. An impression has gone abroad that there is going to be a great stirring up of the car coupler question at the coming convention, and that some new Moses is going to appear who will lead the link and pin hosts out of the wilderness, and defeat the vertical plane supporters and reject their coupler, now the standard of the M. C. B. Association. This being the reputed condition of the contest, all the link and pin coupler men seem to be moved to put the salient features of their couplers before the public once more, and our columns have been looked on as a good display ground. When the railroad public begin to display solicitude to find out particulars about any of the couplers, we will willingly find space for the letters describing them, but we will permit the matter to remain at rest till that time.

We do not believe that any important results will be achieved by those who are striving to regain the ground lost by the link and pin coupler interests at the last four or five conventions. If the members of the Association were all to vote on the car coupler question, and were to act on their sincere convictions, we believe that a majority of the poll would be in favor of the link and pin or of automatic couplers actuated on this principle. But no party has ever been more miserably led and managed than that representing the link and pin interests. One cannot keep close notes of the talk to be heard round a convention without being forced to the conviction that the link and pin coupler men have great voting strength in the Association, but when the two types of couplers came up for discussion the silence of the link and pin men has been as marked as the able, outspoken aggressiveness of the vertical plane men, and when a vote was called for which was calculated to bring the latter type of coupler into prominence and to put in the shade the link and pin interests, the friends of the latter were nearly always silent at the wrong time, and generally managed, through some blunder, to give full and unstinted support to their opponents. The friends of the vertical plane type of coupler made a long, persistent fight in favor of the style of coupler they thought best adapted to railroad service, and by persistence and good management they induced the railroads constituting the voting power of the Master Car-Builders' Association to declare the vertical type standard. People who think they can reverse this decision by a little agitation in favor of the old type do not realize how slowly great bodies are put into motion. Railroad companies do not readily act as a unit to effect an important decision, but when they do so it takes tremendous pressure to effect a change.

Some of those who say they originally favored making the vertical plane coupler standard, now assert that experience with the coupler has convinced them that the principle is not practicable for freight car service. On the other hand, we have heard of several leading railroad men who, during the past year, have become converts to the vertical plane type from seeing its performance in service. We do not think that the experience with the coupler thus far is sufficient to condemn or to make it. It may and it may not be the correct principle of the future freight car coupler; but one thing is certain, the question is going to be finally decided before the Master Car-Builders' Association takes any more action in the matter. If the principle is the correct one it is going to have the chance to demonstrate its merits; if it has inherent faults that make it weak, dangerous and expensive all the friends that a Vanderbilt or a Gould could purchase for it would not keep it in use five years. If railroad men and others will only possess their souls in patience, the car coupler question will solve itself in a very few years.

A daily edition of the *Northwestern Railroader* will be published at Niagara Falls during the Railway Master Mechanics' Convention, and the same thing will be done at Saratoga while the Master Car-Builders' Convention is in session. These daily editions have been highly appreciated by the members and others present at past conventions, and the proprietors of the paper deserve encouragement for the energy and enterprise they display in the business.

The proprietors of the *General Manager* of Chicago announce that in their June number they are going to publish a full page colored cartoon with portraits of all the officers of the Master Mechanics' and the Master Car-Builders' Associations.

Personal.

Mr. Donald McDonald has been appointed assistant general manager of the Chesapeake & Ohio, with headquarters at Cincinnati, O.

Mr. John W. Cloud, Buffalo, N. Y., late superintendent motive power of the Erie has been appointed secretary of the Master Car-Builders' Association.

Mr. H. Monkhouse has been promoted to the position of general foreman of the Chicago, Rock Island & Pacific shops at Herington, Kan.

Mr. Edward Hoyt, purchasing agent of the Oregon Railway & Navigation Co., has resigned that position on account of ill health and has gone to Cincinnati, Ohio.

Mr. William Thow, engineer of the South Australian Government Railways, has been appointed to a similar position on the New South Wales Government Railways.

The Kansas City, Wyandotte & Northwestern has placed an order for 3 new locomotives, 100 box freight cars, 3 cabooses, 2 chair cars and 2 combination passenger coaches.

Mr. J. N. Barr, superintendent motive power of the Chicago, Milwaukee & St. Paul, has passed through a period of serious sickness. His many friends will be pleased to learn that he is now very much better.

Owing to the action of the officials of the Port Jervis, Monticello & New York in cancelling a Sunday excursion which Mr. Charles Clark, superintendent, had arranged for, Mr. Clark has tendered his resignation, which has been accepted.

Mr. Thos. Howard, master mechanic of the Delaware & Hudson Canal Co., and long in charge of the principal repair shops of the company at Oneonta, N. Y., has resigned after a service of sixteen years. Mr. Howard is open for another engagement.

Captain Wade, the very able superintendent of the motive power of the Richmond & Danville, has had his jurisdiction extended over the Georgia Pacific and some smaller roads, which increases the territory under his supervision by about 500 miles.

Mr. C. H. Foster, who has for several years filled the position of mechanical engineer of the Chicago, Rock Island & Pacific Railroad, has accepted a position with Fraser & Chalmers, of Chicago. Mr. Foster is a young mechanic, who by burning the midnight oil prepared himself for a higher position than that of a gang boss, and we regret to see that he has gone out of railroad employment.

Mr. Thomas Midelton, locomotive superintendent of the New South Wales Government Railways, who has been noted for his advocacy of the American types of railway machinery, is about to retire from his position. He has been bitterly assailed in the British engineering journals by the advocates of English styles of rolling stock. Mr. Midelton is a member of the American Railway Master Mechanics' Association.

Mr. J. S. Patterson, master of machinery of the Cincinnati, Indianapolis, St. Louis & Chicago railway, has resigned. Mr. Patterson has been noted for the ability he displayed in running the mechanical department of this company at exceptionally low expense, although he was wretchedly supplied with the facilities for doing the work cheaply. His was a success achieved by untiring industry, constant watchfulness and good management.

Mr. W. S. Mellen, general manager of the Wisconsin Central, who has just been elected general manager of the Northern Pacific, is still a young man, about 43 years of age. He was brought up on the Chicago & Northwestern, and has been an exceedingly popular officer, but still one not to be trifled with. His excellent management pulled the Wisconsin Central in three years out of a mire of insolvency on to the solid ground of financial prosperity.

We regret to announce that Mr. William J. Trace, who has for several years held a highly responsible position in the business department of the NATIONAL CAR AND LOCOMOTIVE BUILDER, died suddenly of pneumonia on May 15. Mr. Trace was a young man of very pronounced business ability, which was backed by untiring energy and perseverance, and his integrity was enviable. His pleasing, genial manner made friends for him wherever he went or with whoever he transacted business, and a large circle of warm friends regret his early death. A very sad incident in connection with this sad event was that his young wife was confined a few days before the death of her husband.

A hospital is to be erected in Chicago in memory of the late Thomas J. Potter, who was so prominently identified with the management of the Chicago, Burlington & Quincy and Union Pacific railways. The original plan was to erect a heroic bronze statue of Mr. Potter, but it has now been decided to perpetuate the memory of this most popular railway manager by building a hospital in which railway employés can receive free treatment. Such a hospital was one of the pet schemes of Mr. Potter, and he was untiring in his efforts to put it into effect. Among those most anxious for the substitution of the hospital for the monument was Mrs. Potter. Few railroad managers ever took a warmer interest in the personal needs of railroad men than Mr. Potter, and a hospital is directly in the line of benevolence he would have been likely to encourage.

General Adna Anderson, one of the ablest and best known engineers in America, committed suicide on May 14, while temporarily insane. He began work as an engineer in 1847, and during the succeeding 14 years was employed on many railroads North and South, East and West. By the time the war broke out he had gained so much eminence for ability in his profession, that he was appointed Chief of Construction Corps of the Army of the Potomac. He rose rapidly, and at the close of the war was acting as chief engineer of all the military railways. Returning shortly after to civilian life, he occupied numerous important positions on railroads, and in 1880 he was appointed chief engineer of the Northern Pacific. In 1886 he was elected second vice-president of the road, and held that and the position of chief engineer until last year, when he retired. At the time of his death he was president of the Steel Car Company, organized to build tubular steel cars.

Copying American Tools.

In our issue of last March we commented on the action of John Holroyd & Co., of Manchester, England, who copied the engravings of tools found in the catalogues of the Brown & Sharpe Manufacturing Company, the Pratt & Whitney Company and the Morse Twist Drill and Machine Company, without permission, and intimated to the trade that they were manufacturing the tools copied. The firm first named appear to be deeply offended at our remarks, and letters protesting against our criticism have appeared in several English mechanical journals. After defending what they had done respecting imitating the design of tools, and claiming that the practice is quite fair, honorable and legitimate, John Holroyd & Co. say in the *Ironmonger:*

With regard to our having copied Americans' catalogues in the production of our own, we do not deny that, being at the time a new company, and anxious to get our price-list before the public with all possible speed, we did, in order to save the time which would have been involved in the production of new photographs or drawings, make use of a number of American woodcuts representing machines similar to, but not quite identical with those we are making, though even in our catalogue most of the designs are modified in some particulars, as can easily be seen by comparing the two. We are not aware whether all the machines shown in the American catalogues referred to were originally invented in the States or not, but we do know that several of them have been made in this country for years by various manufacturers; nevertheless, if the American makers feel themselves aggrieved by our action in copying anything from their lists, we hereby beg to tender them an apology, and think it somewhat unfortunate that they did not, in the first instance, take advantage of the English law of copyrignt. Had we supposed that it would have afforded them any gratification for us to mention their names as the original designers of the machines from which our own have been adapted, we would gladly have inserted them; but if we had done so we should rather have expected to be charged with making an unauthorized use of their names, and with attempting, under cover of their reputations, to pass off as exact reproductions of American make tools which in reality were not so. We will take care to rectify the omission complained of in the next edition of our catalogue, and meantime we have pleasure in stating that the principal makers of the machines and tools used by us in the manufacture or design of our own were the following celebrated American firms, viz.: The Brown & Sharpe Manufacturing Company, the Pratt & Whitney Company, the Morse Twist Drill and Machine Company.

Means of Self-Improvement for Mechanics.

A mechanical drawing class under the instruction of Mr. A. Haviland, of the mechanical department of the New York Central, was maintained all last winter in connection with the reading rooms at New Durham, N. J., supported by the West Shore Railroad Company. The class started out with 25 members and in three months it dwindled down to 8. Those who attended throughout are reported to have made gratifying progress in drawing. A supreme cause of discouragement all over the country to those who are willing to give money, time and labor to support evening schools for the instruction of mechanics, is the difficulty in getting the young men for whose benefit the schools are instituted to attend. A young man with no education beyond a very elementary acquaintance with the three Rs, drudges along for years in a shop without interesting himself in the remotest degree in the principles which the persons must understand who keep the shop running, and by degrees younger men, who have studied and learned, begin passing to the front, and the man who has imbibed all the fun and amusement going, but has kept strictly aloof from study, begins to growl that there is no show for an American mechanic. And he keeps up the growl and becomes disgusted with the trade, and advises young men to keep clear of it. There is really small prospect of advancement for the man who does not have perseverance and ambition enough to help himself; but the trades are not different in this respect from other lines of business. It matters not to some men what libraries may be free and open, what reading rooms may be formed, and what mechanics' classes may be established, for they take no interest in such things, and those who help to form such means of assistance to workmen can do little to make them a success if the men persistently keep away. There must always be hewers of wood and drawers of water—drudges at menial labor—and the men who show they have an affinity for such work by refusing to prepare themselves for higher avocations will get the drudgery to do in the long run.

Why a Car Journal Will Not Stand the Pressure Put Upon a Crank Pin.

In the course of a private letter, a master car-builder writes: "I am in favor of a short journal for the new standard axle, and I shall vote for nothing longer than 7 inches. This reduces the leverage that so often causes breakage, and there is no objection that I can see to the short bearing. At some of the club meetings they have been trying to make out that the pressure per inch of bearing must not exceed 300 pounds. You know this to be nonsense, for the bearing on the crank pin of a locomotive stands five or six times that pressure without inclination to get hot. Inferior lubrication is the cause of car bearings getting hot. I am in for as good lubrication as they use to keep locomotive crank pins cool."

We mention this case because others may be influenced by the same fallacy in their desire to have the journal kept short. Because a crank pin connection runs cool with a pressure approaching 2,000 pounds to the square inch, it does not follow that it is possible to make a journal run cool with one-quarter of that pressure per inch. The relaxing of the pressure on the brass of a crank pin connection a each change in the direction of the piston's motion permits oil to get between the brass and the pin. In an ordinary journal bearing there is a constant pressure of the brass upon the journal, and oil cannot get between the surfaces freely enough to prevent heating when the pressure is very great.

Leather Brake Shoes.

We learn from Mr. Thos. Midelton, locomotive superintendent of the New South Wales Government railways, that he is using brake shoes made of compressed leather. The coefficient of friction is so much greater between the tire and a leather shoe than it was between steel and cast-iron, that an air pressure of 30 pounds operates the brakes as well as a pressure of 75 pounds acted with cast-iron shoes. The leather shoes are made out of the offal and refuse of leather cuttings, that would otherwise be thrown away, and the material is subjected to a process of manufacture similar to that passed through by the substances used in making of Allen paper wheels. Mr. Midelton says that they find a decided advantage in the use of leather brake shoes in wet weather, as the moisture makes little difference in their retarding effect.

One of the serious dangers that attend traveling alone in the compartment cars that form the ordinary railway car all over Europe is that of suddenly being over-powered by a concealed robber and murdered. This has happened over and over again, and every time that such an outrage happens an agitation is raised to provide some means by which passengers can communicate with the guard. But the nature of the small secluded compartment makes proper means of communication impractical, and there will be no real remedy till cars are introduced which are habitually traversed by the trainmen. Another of these recurring murders has lately happened, this time on an Italian road, the victim being the son of the Swiss vice-Consul at Cannes. The crime was committed while the train was in motion, and the body after being robbed was thrown out of the door and found in a terribly mutilated condition. At the official inquiry which was made a week later, the Italian Prime Minister was asked what measures had been taken for protecting the lives of travelers on railways, and in his reply he said that the unfortunate victim was murdered while asleep, so that he could not have made use of an alarm bell even had one existed—which shows the essentially dangerous nature of the compartment systems. Europeans are very ready to criticize American railway methods, but no one yet ever heard of a traveler being murdered in an American railway car, either asleep or awake.

The Burton Stock Car Co. has contracted to build at its Wichita shops a " perfected " palace horse car for C. J. Hamlin, President of the American Glucose Co., of Buffalo, N. Y. The car will be for private use, and will be used for the transportation of his 16 horses, valued at $250,000. The car will be equipped with passenger trucks, steel wheels, Westinghouse automatic brake, Miller and Janney interchangeable buffers and monitor roof.

Wood-Working in Scotland.

The time is within the memory of men still living when all kinds of wood cutting done in Scotland were performed by manual labor alone. The change from hand work to machinery was slow and was opposed by curious conservative influences. Even now it requires argument and reasoning to convince many people that the general adoption of wood-working machinery has been a blessing to the country. Mr. James Bell, of Dundee, recently writing to the *Timber Trades Journal*, makes the following points in favor of machinery:

To the invention and improvement of all kinds of wood-working machinery does the present large consumption of timber owe its development, for, without the means of manufacturing the timber cheaply, and on a large scale, it would be of little use to us, and consequently would not have been imported. The change that wood-working machinery has produced has been very great. In addition to the great saving of hard manual labor, it has given employment to untold thousands, both at home and abroad, as well as on our waters. In fact, one could enumerate scores of instances where the improvement of the wood-working machine could be traced as the primary cause of the flourishing condition of many a business. For example, look at the shipping required to carry our supplies. It has first to be built, thus giving employment to quite armies of men. Then there are the sailors required to man the ships, the amount of employment the handling of so large an import gives, and the great impetus this business gives to railway traffic, for it takes no mean place in the traffic returns. I might go on long enough pointing out how many industries owe their existence and development to the improvement of the wood-working machine; but I am sure there is no need for more being said on that head. I shall simply pass on and note a few of the changes which have taken place owing to the introduction of wood-working machinery. By its general adoption it has saved the workman from great bodily labor. Who that has seen a pair of sawyers cutting a log—their principal attire being spectacles and a red nightcap—but would say that it was scarcely work for men? and certainly the method adopted was one of the most primitive inventions. It sadly needed reforming, both on account of the hard labor involved and the inaccuracy of the work performed, and yet you will find some people who will tell you that they liked the hand sawyer's work better than work done by steam saw-mills. The real reason for this is that the sawyers were obliging enough to put a draught up the centre of the log first, and let the owner see if there was a fortune inside of it. But these people do not care to tell you how many different thicknesses they could supply you with all from the same board, as usually you could get almost any size, the work being so irregularly performed. In addition to the heavy nature of the work imposed on workmen, considerable loss of timber was caused by the hand labor, as it could not be possible to approach the accuracy of the log frame for breaking up logs into boards.

The Union Switch and Signal Company has greatly improved its facilities for capacity at its works at Swissvale, and is now employing 200 hands in the shops in addition to about the same number on the road erecting plants. The most recent and probably the largest pneumatic plant of this kind ever ordered is now being built by this company for use at the Union Depot and yards at Kansas City, where in about 60 days it will be in full operation.

Manufacturing Standards.

At the May meeting of the American Society of Mechanical Engineers, Mr. James W. See submitted a highly interesting paper on "Standards." He begins by describing how an old watchmaker used to make a watch, and the pains which he took to have none of the parts interchangeable with the parts of any other watch, and how industriously he labored to fashion screws that other watchmakers could not reproduce readily, the idea being that this would bring his own watches back to himself for repairs. The fallacy of this business theory has now been exploded, continues the author, and the watchmaker of to-day understands that, other things being equal, he whose watch is the most readily repaired has a distinct advantage in sales. He would seek by all means possible to avoid the use of a screw which could not be produced by a stranger called on to repair a watch. Should he discover that twenty of his fellow manufacturers were making watches requiring a particular screw, and that they were supplying such screws for repair purposes to watch repairers generally, he would quickly modify his own watch so that the repairer could use these screws.

Carrying this idea far enough, it will be apparent that many watch manufacturers will be making the same kind of screws, and many watch repairers buying such screws. We shall further see some enterprising screw-maker setting up in business for himself, and making these screws for supplying the entire demand. Here we have the first sub-division of manufacture. The sub-division must be based upon two facts, viz.: First, that there is a large demand, from several different sources, for identically the same screw; and, second, that a screw-maker can make all these screws better and cheaper than his several patrons could in small lots. The first fact finds many illustrations in the arts to-day, and grows out of the recognition of the new business principle which the old watchmaker combated. The second fact is a firmly established one. There are two further facts growing out of the new system. One is the fact that a watchmaker's product is none the worse because some of the details employed are identical with the excellent details found in the product of a competing manufacturer. The other is the fact that the modern watches are easily and properly repaired.

The idea that it was good business policy to make things that nobody else could fix has not been so long abandoned. Twenty years ago certain locomotive builders employed in their construction an odd size for bolts, and an odd threading, which made, and was intended to make, a great deal of trouble in repair shops. No locomotive builder of to-day could live under such a system.

Modern industry, especially in metal working, is based largely upon specialties. A manufacturer's specialty may lie in the fabrication of a certain detail of an aggregated product; or it may lie in the fabrication of a certain detail of a detail; or it may he in the aggregation of various details produced by others, his operation being confined to the work of assembling the details, and the fabrication of certain elements of conjunction. We can readily imagine the ancient watch-maker producing every wheel and pinion, and plate, and case, and hand, and main spring, and hair spring, and dial, and crystal of the watch which he would present as of his own manufacture. The material which he operated upon consisted of sheet metal, wire, glass and the raw material of porcelain manufacture. The watch-maker of to-day makes few of these things and sometimes none. We have the makers of watch cases, who may or may not make all of the parts constituting the case. The makers of movements may make every part constituting a movement, but more than likely he buys his mainsprings from a special manufacturer, hair springs from another manufacturer, pinions from another, screws from another, hands from another, and dials from another. Probably the party who supplies the dials merely configures the dials purchased from the manufacturer, who, in his turn, procured the back-plates from still another party.

In this way almost all our modern industries are sub-divided into separate industries mutually dependent on each other for demand and supply. It seems the policy of the American manufacturer not to bother with a detail which he can procure of a satisfactory quality, at a cost less than that of its production in his own establishment; and it seems also the policy of the American sub-manufacturer to devote himself to such an extended manufacture of a given detail, that he can make it to the interest of the dominant manufacturers to let the manufacture of his specialty alone. It will be readily understood that a single detail of the product, receiving the entire attention and thought and application and capital of the manufacturer concerned, will be more cheaply produced, and of higher quality than if the same detail was treated as a mere element in the factory engaged in the fabrication of a vast combination of elements.

The effect of the modern system of sub-division of product details has been to demand that there should be a uniformity of details, that is, an interchangeability among the individuals of the same class. To secure a reliable uniformity of excellence in the general character of the purchased details of mechanical structures constitutes one of the continued strains upon the manufacturer, and it may be said as a general fact that standards of uniformity have been most thoroughly established in those branches of trade in which the fewest numbers of parties are interested.

The manufacturer of gas-fixtures is seldom the manufacturer of gas-burners, but his fixtures must receive the burners of the market; and the burners of the market must, obviously, be so made as to fit the fixtures obviously intended to receive them. From this necessity springs a standard gas-burner thread, acknowledged alike by makers of fixtures and makers of burners. This standard embodies an unwritten law accepted by the very few who are interested; a law which would soon be violated and abrogated by the multitude working in ignorance or out of fellowship. *The law is not of record.*

It does not follow that, because the burner-makers and the fixture-makers have settled on a standard size and thread, that size is the best that can be chosen. It is, however, certainly better that these things should be uniform, than that a few should be better and many worse, and all different. Uniformity in such case is of itself a superior merit. The mere selection of a standard is evidence that it possesses some inherent merit. The establishment of a standard does not prevent the later substitution of a better one. It is safe to assert that it is far easier to revolutionize a standard for betterment than it is to establish a standard in the first place. The difficulty in establishing a standard is generally due to differences in opinion as to what is the best, though often the matter is deferred in the hope of possibly reaching an impossible ideal. It would appear to be a much better policy to adopt something fairly satisfactory at once. Effort toward betterment would then be concentrated, and might result in something worthy of eventually being substituted for that which has been adopted.

A few years ago there was no established height for the coupling of cars. Each railroad was a law unto itself. Thirty-three inches from rail-top to draw-bar center was finally settled on for a standard. While it is being determined whether this is two or three inches too high, or three or four inches too low, we can possess the boon of uniformity.

It is certainly within the memory of many of the members when wrought-iron pipe was made of hap-hazard size by different makers, there being no uniformity of size among the different makers, or among the products from the same maker. I remember, in 1865, putting new pipes into a feed water heater. The old pipes were what was called seven-eighth pipe, something no longer made. They were four of these pipes in the heater, connecting with unions, etc. None of the threads were of the same size, but each pipe end had been fitted and marked to its individual hole.

The whole gas pipe business was an unmitigated nuisance on account of the lack of system, and the necessities of the case were recognized by the limited number of manufacturers interested, and at the present day there is a standard size for each pipe. The sizes as to diameter of pipe, diameter of threaded part, number of threads per inch, and taper of the threaded portion, are purely arbitrary, and present to us criterions of absolute perfection when memory goes back to the pipe of old. What is called a ⅛-inch gas pipe has about a ¼-inch hole in it, but it always has such a hole, and we know it. The result of the standard system adopted in the manufacture of pipe is that a pipe made in Philadelphia, another piece made in Chicago, a coupling made in New York, a valve socket made at Dayton, and a tap made in Hartford, will all represent identically the same understanding of intended sizes.

Mr. See proceeds to tell that there is no law or record which tends to maintain or to identify the exact sizes in established standards. New manufacturers and others are therefore constantly liable to get making pieces which deviate slightly from the proper sizes, because in establishing their plant they have no authority to refer to for exact dimensions. The paper proposes to obviate this danger of falling into confusion of sizes by establishing a Government Bureau of Standards in connection with the Patent Office. The author quotes a great variety of articles which must be purchased in different parts of the country to repair or replace similar articles, and which ought to be made uniform, but are not. The list contains many things which are popularly supposed to be uniform, but are not. In studying out the lists given in the paper, one is gratified to find that the railroad master car builders and master mechanics have performed more practical work in establishing standards than all other industrial or engineering organizations combined.

The paper proposes that all scientific, industrial and engineering societies shall combine to use their influence with Congress to get the bureau of standards established. The following is the plan as outlined in the paper:

BUREAU OF STANDARDS.

It is proposed that there shall be a governmental Bureau of Standards in which any respectable representation of a trade or craft, after adopting a standard, may file the same. It is not proposed that the use of such established standards shall be compulsory, but it is proposed that the party representing his goods as conforming to standard, shall be measured by something of respectable significance. It is proposed that governmental oversight will insure a more accurate definition of standards than could be otherwise arranged for. It is proposed that governmental oversight will guard against confusion of standards. It is proposed that, after a standard has been established, a description of it can be procured by any interested party on payment of reasonable fees. A government publication of an established standard is proposed.

BUREAU ORGANIZATION.

It is believed that the proposition for a Bureau of Standards could be satisfied by a single additional division and examiner in the Patent Office. The nature of the proceeding, and the character of the inquiry, and the judicial qualifications on the part of the examiner would seem in direct line with the present line of duties of the Patent Office. The Patent Office has now to do with mechanism and things of commerce and industry; has to do with drawings of such matters; has to do with descriptions of such matters, and with sharply defined claims pointing out the meat of the description; and has to do with illustrative models and their careful preservation; and has to do with photographic reproduction of drawings, and the printing of specifications of patents whereby any one can get any patent copy for twenty-five cents; and has to do with the publication of the *Weekly Gazette*, containing drawings and claims of every patent as issued, every Tuesday morning. The Patent Office would, therefore, appear to be peculiarly equipped for the proposed work. The installation of the new division would require simply the law, and an additional room in the Patent Office.

Requirements of a Good Tender Truck.

At the May meeting of the Northwestern Railway Club, Mr. William McIntosh, Chicago & Northwestern Railway, read the following paper:

In introducing "Tender Trucks" for discussion, I was influenced by the fact that "Car Trucks" was the subject immediately preceding, and to my mind there is considerable affinity between the two, although their general service varies greatly. The car truck starts from the Atlantic seaboard for a journey west, and often months elapse before it returns. During this interval it passes over many different roads, and unless its general construction is approximately the same on all roads much confusion and delay will be occasioned by an accident to one or more of its parts. The necessity of having the car truck of one general standard is apparent.

The tender truck, however, is not changed from one road to another, but remains on one system and usually attached to one particular engine. Therefore, the same necessity for a general standard does not exist as in the car truck. Yet it will be admitted by all interested that a standard tender truck embracing the best points of the many different kinds would be of great benefit. There are a large number of different kinds in use, each locomotive builder making a truck peculiarly of his own design; and most large railway systems have one or more so-called standards of their own. Were it necessary to transfer tenders from road to road, as cars are transferred, a perfect babel of confusion would result. Let me ask, why should this diversity of construction exist? Is not the service demanded nearly alike on all roads—the only difference being in the larger or smaller load carried, according to the amount of fuel and water required?

I think there is a general tendency toward providing greater capacity of tenders, particularly as regards the quantity of water, which is a move in the right direction. This will reduce the number of stops to a minimum, and in Western countries where the water supply is often limited and of poor quality will allow the passing of water stations furnishing noticeably bad water, thus resulting in less wear and tear to machinery and a corresponding increase in the life of flues and fire-box sheets, which would far more than counterbalance the disadvantage of increased load.

I presume the equalized, center-baering truck, with swinging bolster, would be the favorite with most mechanics, and it no doubt embraces the best mechanical points. But it has such a variety of parts that its theoretical perfection is somewhat clouded by wear on hangers, equalizers and other members. In practice it does not possess the many advantages claimed for it over the much abused wooden transom truck with the large springs resting on the journal boxes. And in this connection I would inquire, is there a better place for the spring to rest, providing, of course, that allowance is made for the necessary freedom of action? Having had considerable experience with this type of truck, and knowing that it is capable of furnishing good service, I am unwilling to permit its condemnation without saying a word in its

favor. I am aware that it is lacking in mechanical perfection; yet its simplicity of construction, freedom from breakage, nominal cost of keeping in repair and the easy accessibility of all its parts are points in its favor. Flange wear only results from faulty construction or neglect of ordinary repairs; the same trouble would be encountered from the same cause with the most elaborately constructed device. I think with a few improvements this truck can be made to give as good results as any in use. I would suggest a rolling contact between top of spring and upper pocket, and that the bottom of spring rest on an inverted clutch hanger suspended on a pin passing through sides of lower pocket. I recently noticed an arrangement of this kind on a G. B. W. & St. P. engine, and consulted M. M. Fenwick regarding its merits. He informs me that it is a decided improvement on the sliding contact; also, that it is not patented and is free to the public. About the only move toward uniformity in the construction of tender trucks is the adoption of the M. C. B. axle by the Master Mechanics' Association, and this axle has proved itself admirably adapted to the service. Not many years ago, on the divisions with which I am connected, the largest tender truck journal was $3\frac{1}{2} \times 5\frac{1}{2}$ inches, and hot boxes were common enough. Then the engines were changed from wood to coal burners, and with the heavier loads on tenders hot bearings were of daily occurrence. Later, axles $3\frac{5}{8} \times 6\frac{1}{2}$ were substituted and trouble in this respect greatly reduced. Now we have the M. C. B. axle under our heaviest tenders and in all new trucks, and a hot bearing is rarely encountered. In conclusion, I cannot call to mind any serious objection to adopting a truck of one common standard for either cars or tenders. Such an arrangement would effect a large saving to railroads by reason of the reduction in quantity of material required in stock and by the cheapened construction and repairs—having but one instead of many different kinds of trucks to make and keep in order. Possibly there are serious objections to this proposition which have not occurred to me, and I hope discussion will bring out a free exchange of ideas, for the subject deserves considerable attention.

The firm of Thomas B. Inness & Co. and Perkins and Mott, consolidated on May 1, under the firm name of Thomas B. Inness & Co.

The office of the Butler Draw Bar Attachment Company has been moved to the Phenix Building, Chicago, Ill., where all correspondence should be addressed.

One of the Jewett steel plate trucks, which have been so favorably commented upon and so successful in use, will be exhibited at the Master Car-Builders' Convention.

The Wagner Palace Car Co. are putting on some of the new Scarritt chairs, which are the acme of perfected comfort and handsome in appearance. These are similar to the chairs furnished by the Scarritt Car Chair Works to the Pullman Palace Car Co.

The growth of their business beyond their present manufacturing facilities has obliged the Hall Steam Pump Company to consider the question of larger shops. Plans for a shop 60 × 200 have been prepared, and it will probably be built during the coming summer, in Wilmington, Del., where their present works are located.

The Stearns Flexible Car Axle Box has been specified for the cars of the Suburban Rapid Transit Company, of New York. Specification for several of these cars are now out, and the Stearns box is being manufactured for them by the American Railway Equipment Company.

During some United States Government tests of different metal for bearings a journal was run under a Magnolia metal bearing loaded to 600 pounds per square inch, run continuously for seven hours. The bearing stood the test with an increase of temperature from 86 degrees to 117 degrees Fah.

Mr. Wm. P. Williams, Chicago representative of Richard Vose and National Car Spring Company, New York, Car Springs, has changed his quarter to 436 The Rookery, and has associated with him his brother, Mr. Geo. T. Williams, and together they will look out for the interests of the firm named.

The Hale & Kilburn Manufacturing Company, of Philadelphia, Pa., have sold and had in actual use in about two years prior to May 25, nearly 21,000 of their high back tilting car seats, in addition to the many thousands of their original short automatic striker arm seats used on the Pennsylvania Railroad system.

The Chicago, Burlington & St. Paul are making many improvements in their equipment, among them putting on the Scarritt chairs—their latest improved. The Scarritt Works are at St. Louis, and they are full of orders for their different styles of seats and chairs, on which they have lately made many improvements.

The firm of Edward Smith & Co., manufacturers of varnishes and coach colors, composed of the undersigned, is this day dissolved by mutual consent. The business will be continued by a corporation of the same name, under the management of the former partners, Chester Huntington, John A. Elmendorf and Alexander Maitland. 158 William street, New York, May 15, 1889.

The Standard Car Coupling Company are the successors of the Consolidated Car Coupling Company. The mechanical experts belonging to the new company have made important improvements on the Dowling coupler, and the intention is to put it on the market at once. The coupler is now reported to possess, in a marked degree, the merits of simplicity and strength which insure durability in service.

Increased business and the necessity of more ample accommodations have caused B. F. Sturtevant, manufacturer of blowers heating apparatus, engines, etc., to move his New York branch office to No. 91 Liberty street, where he will be better able to meet the trade.

He has also recently established a branch office at Portland, Oregon, under the management of Mr. O. C. Gore, who will handle the rapidly increasing trade of the Pacific Slope.

Piles of brick, mortar and lumber, and a large force of masons and carpenters at work, show that Stewart Hartshorn, Newark, N. J., has found it necessary to add to his previous large plant to obtain room for his business of manufacturing shade rollers. Adjoining land has been purchased, and with additional space promptness in the filling of orders will be assured on his rapidly increasing trade. All buildings are of solid masonry, and every precaution has been observed in obtaining strength, safety from fire, and well ventilated, light work rooms.

Continued reports are coming in as to the success of the Servis Tie Plate. Large orders have been placed last month by the Maine Central, for twenty miles, by the Chicago & Northwestern, and other roads, and the Pennsylvania R. R. have placed trial orders for same.

The Dunham Manufacturing Company, with their usual enterprise, now offer the Davies spike, which, although a marked change, is certainly a marked advance, which, in connection with the tie plate, gives benefits beyond those of any brace.

We have received an illustrated circular showing the Morrell reversible trailing deck ventilators, a new system of ventilation for railroad cars, introduced by the International Manufacturing Association, New York. The following "opinion" of the system of ventilating appears to apply very fairly: "The mechanism of this device is simple and strong. All the window openings are controlled to the exact degree desired. They can be closed if necessary, or opened enough to thoroughly distribute the current of air through the length of the car. The appliance marks a decided advance in ventilation, which the public ought to hail with gratitude in view of the enormous travel by rail and the impure air they are compelled to breathe."

The E. D. Albro Co., Cincinnati, O., report the demand for veneers, thin lumber, hard wood lumber and mahogany to be steady. Furniture manufacturers and railroad companies find the firm always prompt in filling orders, and they carry a large stock of all kinds, assorted thickness, and well seasoned.

The manufacture of panels is a product they have added to their large business within a few years, and is meeting with good success. They are made three ply, with grain of center running crosswise. Also desk and table tops made three or five ply.

Having excellent facilities, they are enabled to use all their odd sizes of veneers and thin lumber, and they can make the panels, desks and table tops at less price than the manufacturers can make same in their own manufactories. Samples of their work can be sent by mail.

A Good Car-Lighting System.

The Railway Lighting and Heating Co., Philadelphia, are meeting with extraordinary success in the lighting of passenger cars by the Frost dry carburetter system. By this system, the gas for lighting is produced in a metallic box, placed on the outside of the car, and filled with cotton wicking saturated with gasoline, through which air is passed from a connection with the brake-pipe. The air carries with it sufficient gasoline vapor to make a very clear and odorless flame.

The carburetter is a round flat box with a hole in the center and having within it a spiral chamber about 40 feet long, which spiral chamber is filled with cotton wicking. The air inlet to the carburetter is near the center hole; the outlet is near the edge. The air which is to pass into the carburetter is taken through a small copper pipe, which is bent in the form of a conical spiral and placed in the flue of the carburetter directly above the lamp. The object of this spiral coil is to heat the air before it enters the carburetter by the combustion from the lamp, and in this way to furnish the heat that is necessary to vaporize the gasoline and generate the gas. As a further means of furnishing heat to the carburetter, it is surrounded with an air space, which communicates with the inside of the car, so that warm air from the car constantly passes arouud the outside of the carburetter and out through the ventilator. Both the ventilator and the cover of the mantle which form the visible outside portion of this warm air space are detachable and may be taken off as occasion requires. When the carburetters are freshly charged, or when the air is very warm, there is a possibility of carrying too rich a gas down to the lamps; to obviate this difficuity a permanent cross connection is made between the air inlet to and the outlet from the carburetter. In this cross connection is a diaphragm with a very small hole, so that a small amount of air is taken across to the gas as it comes out of the carburetter, diluting it a little, and thus preventing any possibility of too rich or smoky a gas reaching the lamp. The system provides a cheap, clean, safe and reliable means of lighting passenger cars.

Steel rucks.

The Fox Solid Pressed Steel Company, Rookery Building, Chicago, have issued an illustrated catalogue of the railway appliances they are preparing to put upon the market. This company have imported very powerful hydraulic machinery to be used in pressing steel into shapes suitable for car trucks, frames and other parts of railway rolling stock. A number of the trucks made in this way are illustrated in the catalogue, and they have the appearance of combining the maximum strength of the steel used with extreme lightness and beauty of form. The effect of introducing this form of construction to railroad rolling stock will be to materially reduce the dead weight at the same time lessening the necessity for repairs. In a car truck shown as suitable for a 60,000 pound car the reduction of weight would be 450 pounds below that of a truck ordinarily used under such a car. There is even a greater reduction made in the dead weight of tender trucks.

The compilers of the catalogue say:

The aim in their production has been to reduce the number of parts that go to make up the whole, to attain great strength combined with lightness, and a very large decrease in the cost of maintenance.

Steel in these trucks takes the place of wood, cast iron and wrought iron, giving only one metal in the construction that possesses complete homogenity and uniform strength throughout. The quality of our metal is testified in each production, for were it not the best it could not stand the severe strain placed on it during the process of pressing. Each production is solid from end to end, being produced by one heat, and under a pressure of 4,000 tons on the entire plate's surface. Each production from the same set of dies (no matter how many) are perfect fac-similes of one another, thus insuring perfect fit, and thereby great reduction in labor of erection. Besides there is the additional advantage that in case of injury by collision, the parts, however much they may be contorted, can be restored by a blacksmith to its original form, and at the end of its career the material is still valuable as scrap.

The time has come when every designer of railway equipment is casting his attention to the use of a material that will give better results than wood in car construction. Great changes have of late years taken place in the increased carrying capacity of cars, and consequently in strength of detail, but the general form and material has been retained. It is surprising that so important a point as an improved form and material has not received more attention; the explanation probably is that almost invariably cars are constructed of timber, and therefore appear to call for less consideration on the part of the mechanical engineer in regard to either their construction or to the machinery for producing them.

Steel has surpassed wood in ships, bridges, and to a great extent in large buildings, and it is considered that steel is destined with equal certainty in the long run to supersede wood in car construction.

Some of the advantages of these trucks are:

1. They are, on an average, each 450 pounds lighter.

2. They are very elastic and meet low joints in the track, and badly laid curves with astonishing smoothness, thus saving the jerks and jolts on the body that are so fatal to the life of a car and wear and tear upon rails and road-beds.

3. Being manufactured from steel of such a nature as to stand a tensile strain of about 25 tons per square inch, with an elongation of about 20 per cent. in a length of 10 inches, the strength and durability are great, with a large reduction in weight.

Our Directory.

We note the following changes since our last issue. Our readers will do us a great favor by giving us prompt notice of any changes that may come to their knowledge or of any error that may be noticed in our list:

Baltimore & Ohio.—Mr. J. T. Odell has been appointed general manager.

Carthage & Adirondack.—G. F. Huggans has been appointed superintendent and chief engineer with office at Carthage, N. Y.

Chicago, Rock Island & Pacific.—Mr. J. H. Bedson has been appointed master mechanic at Horton, Kas., vice Mr. J. H. Kirk resigned.

Cincinnati, Indianapolis, St. Louis & Chicago.—Mr. J. S. Patterson, master of machinery, has resigned.

Cincinnati, New Orleans & Texas Pacific.—Mr. H. F. Clark is appointed superintendent of the Cincinnati, New Orleans & Texas Pacific railway, vice Mr. W. W. Wells, deceased. Office at Somerset, Ky. Mr. W. W. Bond is appointed superintendent of the Vicksburg & Meridian and Vicksburg, Shreveport & Pacific railroads, vice Mr. H. F. Clark, transferred. Office at Vicksburg, Miss.

Cleveland, Akron & Columbus.—Mr. John J. Henry has been appointed master mechanic, in place of Mr. G. M. Taylor, resigned.

Denver, Texas & Fort Worth.—Mr. F. E. Bissell, Chief Engineer, has been appointed superintendent of the Central and Northern divisions, with headquarters at Denver, Col.

Detroit, Lansing & Northern.—John K. V. Agnew has been appointed general superintendent, vice Thomas M. Fish, resigned. The office of general superintendent has been transferred from Ionia, Mich., to Grand Rapids, Mich.

Duluth, South Shore & Atlantic.—Mr. George I. Jarvis, superintendent, has resigned and the position has been abolished.

Jacksonville, Tampa & Key West System.—Mr. D. F. Jack has been appointed general manager. He will have authority over the Jacksonville, Tampa & Key West, the Jacksonville, St. Augustine & Halifax River, the Florida Southern, and the Indian River Steamboat Co.

Kentucky Union.—Mr. George D. Wadley has been appointed general manager.

Mexican Central.—Andrew Smith having resigned his position as superintendent of the first division, from Mexico to Silao, S. O. Lewis has been appointed to succeed him, with headquarters at City of Mexico. M. S. McCay has been appointed superintendent of the third division, from Calora to Jiminez, with headquarters at Jimulco, vice S. O. Lewis, transferred. C. T. McCotter has been appointed superintendent of the Tampico division in charge of the operating and construction departments from Tampico to end of track, with headquarters at Tampico. The office of assistant superintendent has been abolished. E. H. Whorf has been appointed assistant manager, with headquarters at the City of Mexico.

Missouri, Kansas & Texas.—Henry T. Peyton, master mechanic at Hannibal, has resigned, and has been succeeded by John Campbell, of Parsons, Kan.

Northern Pacific.—At a meeting of the directors Mr. William S. Mellen was elected general manager to relieve President Oakes of part of his duties.

Owensboro & Nashville.—Mr. L. S. Robertson has been appointed superintendent.

Pennsylvania.—R. L. Holliday, superintendent of the Bedford Division, has been transferred to the Lewiston Division, with office at Lewiston, Pa., and W. Heyward Meyers has been appointed superintendent of the Bedford Division, with office in Bedford, Pa.

Pittsburgh & Western.—Mr. M. A. McDonald has been appointed general manager, Mr. J. I. Johnston, superintendent, has resigned.

Quincy, Omaha & Kansas City.—C E. Soule has been appointed superintendent, with office at Quincy, Mo., to succeed F. D. Schermerhorn, resigned.

Employment.

WANTED—Position by a Master Car-Builder. The advertiser has had long experience with a prominent road as M. C. B. References can be furnished. Address "Industry," care NATIONAL CAR AND LOCOMOTIVE BUILDER.

WANTED—Position as master mechanic by one who has been in the business for sixteen years and has had charge of the principal repair shops of an important railroad during that period. Best of references. Apply to T., care NATIONAL CAR AND LOCOMOTIVE BUILDER.

NATIONAL CAR AND LOCOMOTIVE BUILDER

JULY, 1889.

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The Union Pacific Railway Company has specified that all cast-iron wheels after July 1 must be made in the Bar contracting chill.

"Pitchforking" is the word used in New South Wales to express that form of transformation of energy which sends a railroad man upwards out of his turn.

In the repair shops of the Burlington, Cedar Rapids & Northern they have been able to dispense with the use of lamps in doing work inside of fire boxes in the day time. They employ discs of sheet tin set in such a manner that the daylight is reflected upon the work on hand. The boiler makers are said to be highly pleased with the invention, as it gives them an atmosphere to breathe which is free from the heavy, greasy odors that kerosene hand lamps give off.

The Central Railroad of New Jersey have made a move in the direction of modern methods of operating by introducing interlocking signals to protect trains passing through the Jersey City yards. There was, however, a bad hitch on the first day the interlocking system was put in service, for the train men did not appear to have been instructed regarding the working of the signals and a bad blockade of trains happened in consequence of this lack of necessary training.

The most complete collection of books on railroad subjects that we have ever seen is in the private library of Mr. H. B. Hammond, President of the Indianapolis, Decatur & Western Railway. Mr. Hammond is a specialist on railroad financial and transportation problems, and he has collected all kinds of books to aid him in the study of these subjects, but he has also probably the best collection in America of books relating to the various departments of railroad engineering.

The Duluth & Iron Range, of which Mr. M. J. Carpenter is general manager, is the only broad-gauge railroad in the world that has its entire rolling stock equipment fitted up with air brakes. During last winter Mr. J. L. Greatsinger, master mechanic of the road, superintended the putting of air brakes on 34 locomotives and 1,122 cars. The business done is mostly the transportation of iron ore, but the trains are moved so promptly and safely that the great expense for air brake equipment is proving an excellent investment.

A most disastrous accident happened on the Pennsylvania Railroad on June 26, near Latrobe, Pa. A switching engine had left some cars standing on a bridge and the crew failed to protect them from a freight train with 42 cars, which came down a descending grade and ran into the obstructing cars at a speed of 25 miles an hour, making a dreadful wreck. Before there was time to send out signals a freight train came in the opposite direction and plunged into the wreck. The smashed cars took fire, and a great deal of property was destroyed before the fire was checked by the local fire department. A number of workmen from Johnstown were on one of the trains, and at least ten of them were killed.

Locomotive 10,000, representing that number built by the Baldwin Locomotive Works, has lately been turned out, and was one of an order given by the Northern Pacific. The engine is a good type of the modern tendency in locomotive designing. She is a consolidation engine, with cylinders 22 × 28 inches; drivers, 50 inches diameter, and boiler, 72 inches diameter. The engine in working order weighs 75 tons, of which 67½ tons rest on the drivers. The boiler contains 271 flues, 2¼ outside diameter, and with the fire-box give 2,293 square feet of heating surface. Mr. W. T. Small, superintendent of motive power of the Northern Pacific, says that the engines of this class already in service are doing highly efficient work. They are used exclusively for handling trains on mountain grades.

In the Grand Central Station, New York, is to be seen the first of two new funeral cars, built in the shops of the New York Central at West Albany, after the design prepared by Mr. Wm. Buchanan, superintendent of machinery of the company, and intended to be used between New York and Woodlawn Cemetery. The car is divided into three compartments. In one end a room is fitted up for the casket; it is finished in mahogany throughout, with a mahogany catafalque upon which the casket rests. Adjoining this is a room designed to afford seclusion to the family and immediate friends of the deceased. The remaining compartment is for the use of the others attending the funeral, and is fitted up in drawing-room style.

Railroad men familiar with car construction, and acqainted with the appliances attached to passenger cars at different times with a view of increasing the comfort of travelers, supposed that the Pullman Company had got a little more than they were entitled to, when they were declared by the courts to have exclusive right to use friction plates as a connection of car vestibules. Yet the Pullman Company are not satisfied, and have entered suit against the Wagner Company to restrain them from using the vestibule as a finished device, even when the friction plates are discarded. We are, however, assured by representatives of the former company that the report which credits them with intending to prohibit all other companies from using steel tired wheels under their passenger cars is without foundation. Railroad men may therefore breath freely again.

Railway accidents are not very numerous in the British Isles, but when a collision happens the fragile character of the cars in use generally causes great loss of life. One of the most serious disasters on record happened last month near Armagh in Ireland. An excursion train carrying a large number of Sunday school children was run in two sections. The second section was so heavy that the engine stalled on a steep hill, and the train was cut in two. The passenger cars on Irish railways have seldom any hand brake, and stones were used to block the wheels of the carriages that were to be left on the grade while the engine took forward the first portion. But the blocking did not hold and the cars ran down the hill, and, before they reached the level track, met a regular train that was following and a terrible collision resulted, causing the death of over seventy persons.

There is nothing more curious about railroad operating than the diversity of opinions of railroad men as to the speed of trains when accidents happen. Railroad men are all supposed to be better able to judge, with some degree of accuracy, the speed of trains, but circumstances have repeatedly indicated that unless it be the engineers who have to regulate the speed, few other railroad men have a better idea of the velocity of trains than people in other employment. A striking illustration of this is given in a recent number of the London *Railway Engineer*. A locomotive pulling a passenger train jumped the track when slowly approaching a signal station, and in an investigation that followed, the trackmen testified that the train was running 30 miles an hour when the accident happened. As the engine only ran 84 feet after leaving the rails before stopping, the government inspector estimated the speed as being about ten miles an hour.

Mr. W. H. Lewis, master mechanic of the Chicago, Burlington & Northern, has been making experiments lately to ascertain the effect of the ordinary methods of counterbalancing the reciprocating parts of the locomotives on the wear of driving wheels. He finds, as all other observant master mechanics do, that there is a decided tendency of the driving wheel tires to wear flat spots on the surface of the tires that forms the short segment of a circle between the two crank pins. This he attributes in a great measure to the swing of the counterbalance weights in the driving wheels tending to slip the wheels at the moment when the rotational effort transmitted through the connecting rods is the greatest. Mr. Lewis believes that more counterbalancing weight has generally been used than is necessary, and he is laboring to find out the smallest weight that can be used consistent with making an engine run steady.

A series of experiments have been conducted by the Dutch State railways for the purpose of ascertaining exactly the relative resistances of various pigments to atmospheric changes, and to the corrosive action of sea water. The results have proved that the red lead paints are less affected by atmospheric influences than those which are composed of the brown oxides of iron on account of their adhering more closely to the metal, and of their possession of a greater elasticity. It was also discovered that any sort of paint afforded an increased protection if the plates were pickled in hydrochloric acid before its application. The prevention of corrosion by salt water was found to be possible by the admixture of the oxide of some electro-positive metal, such as caustic lime and soda, but that the efficiency of such a covering was destroyed when its alkaline properties had been neutralized by the absorption of carbonic acid. Magnesia, however, was proved to be most serviceable, seeing that it does not absorb carbonic acid; and not only does it protect the iron from galvanic action, but it also does not affect the anti-fouling qualities of paint.

On June 13 Mr. Angus Sinclair, editor of the NATIONAL CAR AND LOCOMOTIVE BUILDER, sat on the front end of engine 677, belonging to the New York Central & Hudson River Railroad, during a run with the Chicago Limited Express from New York to Albany, and took indicator diagrams. One diagram was taken about every second mile run. Two assistants, Mr. Phil Lonnergan, chief draughtsman, and Mr. John A. Hill, editor of the *Locomotive Engineer*, in the cab attended to keeping the record of coal and water used. An interesting record has been obtained of the work performed and the fuel and water consumed in pulling a fast express train from New York to Albany, and full particulars will be published in a future issue of this journal. The run from New York to Albany, 143 miles long, is made without a stop in three hours and twenty minutes, being an average speed of 43 miles an hour. There is considerable time lost in slowing up at various points which has to be made up and calls for a running speed of about fifty miles an hour. The train was stopped at Hudson for several minutes, and a spurt had to be made to reach Albany on time, and one indicator diagram was taken at a speed of 62 miles an hour. A somewhat unusual incident of the trip was the cushion on which Mr. Sinclair was sitting taking fire and blazing into flames at a time when the train was running about fifty miles an hour.

The fury of the torrent at Johnstown was something quite beyond the range of prior experience, because in no other occurrence of the kind has such an enormous volume of water been suddenly released at the head of a narrow valley 14 miles long, with so great a fall, about 378 feet from the top of dam to top of the stone bridge at Johnstown. The most vivid evidence of this fact is the fate of the locomotives in the Conemaugh round-house, three miles above Johnstown bridge. There was not one of sixteen or more locomotives at that point which was not carried off 100 to 200 feet; there are about a dozen scattered about in all directions over the torrent-bed where once was Conemaugh, at distances of 400 to 1,200 feet from the former site of the round-house (which is gone, foundations and all), all of them nearly and some of them completely buried in rocks and sand. These locomotives were all or nearly all of the heaviest types of consolidation, being used for mountain helpers, and two of those which were carried farthest lie close together, one having stopped the other. The tenders were mostly carried a mile or more down stream, many of them only stopping at the Johnstown stone bridge, while it is reported that some locomotives are in the jam at that point, which were carried by the torrent clear from Conemaugh. We do not know that this is so, but no one who has seen the wreckage will question that it may easily have been the case. As one evidence of this, Mr. McHenry, one of the higher officials of the Cambria Iron Company, who was standing in the third story of the brick club house, which escaped complete destruction by the flood, testifies that he saw from the window a locomotive go by which appeared for the instant to be floating like cork on the top of the water, 30 feet above the ground! We satisfied ourselves by personal inquiry that this incident actually occurred.—*Engineering News.*

Dis ussing Instructions About Engine Running.

In our last issue we mentioned that Mr. George H. Baker, an unusually well-informed engineer, was engaged giving instruction to the enginemen of the C., B. & Q. system about economical methods of firing and of operating locomotives. The "talks" given are said to excite great discussion among the men interested. They will stand about the round house for hours talking about the different points presented in the instructions, and freely giving their individual opinions of the same. A master mechanic at one of the division points was the other day listening to a group of firemen talking about the instructions. Said one: "He said the exhaust in going up the stack was an air pump; that each exhaust filled the inside of the stack just like a piston, and in going up the stack pumped air in through the fire." "Yes," said another, "and he told the engineers that one of the advantages gained by working their engines as far back as they could, was the exhausts were softer and made a lighter draft on the fire, which burned less coal and let the hot gases of the fire stay in contact longer with the flues and heating surface, and we got more heat out of them." Then another said, "Well, then, why the hell don't they put another piston on the other end and pull them back again." There was a roar of laughter from the crowd, under cover of which the listener got away.

The Frost Car Lighting System.

A representative of the NATIONAL CAR AND LOCOMOTIVE BUILDER recently spent part of a day in a large building in Sansom street, Philadelphia, watching the manufacture of the apparatus used in the Frost Dry Carburetter System of Car Lighting, the system which has been adopted by the Pennsylvania Railroad Company as the standard method of lighting for all passenger cars belonging to that road. The work of manufacturing the apparatus used is carried on in a highly methodical manner, special machinery being used for producing the parts so that they are uniform and interchangeable. Sub-division of labor is carried out to the fullest possible extent, so that workmen are kept performing simple recurring operations, at which they become highly expert and exceedingly rapid.

The Frost dry carburetter system of lighting is one in which the volatile oils produced from petroleum are so manipulated that they supply a safe, cheap and brilliant light, which is used very successfully in passenger cars, and is daily working into popularity. It had long been understood that petroleum compounds were capable of supplying the cheapest medium for making a very brilliant light, but great difficulties stood in the way of utilizing it in a perfectly safe and reliable manner for car lighting. The overcoming of these difficulties was the first task undertaken by the inventor of the Frost dry carburetter system. Gasoline was the volatile oil chosen, and the first problem to be worked out was the storing of a sufficient quantity of this compound to supply light for the longest journey, and yet to carry it in a manner which would keep it perfectly free from danger in case of accident. This was accomplished, the use of a reservoir filled with cotton wicking for absorbing the oil maintaining it in a minutely divided condition, and passing through the mass a current of atmospheric air which combines with the hydrocarbon fumes emanating from the absorbed oil, thus forming a mixture that burns with a clear, brilliant flame which pales the best efforts of coal gas and electricity.

In watching the operations in the factory the method of storing the gasoline safely in the carburetters is made clear. A carburetter, as viewed from the exterior, is a round iron box about 30 inches diameter and 4 inches deep, with a hole in the middle about 6 inches diameter. The first move in making this vessel is to take a disk of kalamein iron and perforate it with oblong holes, beginning near the center and circling outward in the form of a spiral. This spiral of holes is punched by a single blow in a press arranged for the purpose, so every perforated disk has the holes of the same size and in the same position. Two of these disks are next secured in a holder about three inches apart, and a workman begins and works a strip of kalamein iron round on the blank space between the openings of the perforated spirals and solders the strip on each side, thus securely fastening the two disks together, and making a spiral passage between them about 40 feet long. This box is next held on its edge on a bench where with the aid of suitable machinery two boys weave cotton wicking tightly through the perforations. When this work is done the carburetter is completely filled with cotton wicking. This is the method of subdivided storage adopted, and is the heart of the apparatus. The other details were prepared and applied to make safety sure and to regulate temperature and supply. Air taken from the air-brake pipes, but reduced in pressure and regulated by special appliances, is passed under a pressure of about three pounds per square inch into the carburetter by an opening near the center of the vessel, and this air, passing through the long spiral passage, takes up all the gasoline vapor necessary to make the light-giving hydro-carbon.

The inside box is, for safety, inclosed in a casing of heavy, seamless, sheet copper, through which the pipe connections are made, and again, outside of this case, is a covering of double sheet kalomein iron, having a lining of non-conducting material between the sheets.

The details and attachments that were necessary to make this a reliable, easy operated system of car lighting, have been most ingeniously worked out, and their perfection bears testimony to the presence in the company of a master inventive mind. The carburetter, perfect as its design is, would not generate gas freely unless the air passing through was of a certain high temperature, and to maintain this temperature, the air is made to pass through a small coil of pipe to which the flame of each lamp imparts heat. As a further means of furnishing heat to the carburetter, it is surrounded with an air space, which communicates with the inside of the car, so that warm air from the car constantly passes around the outoutside of the carburetter and out through the ventilator. Both the ventilator and the cover of the mantle which forms the visible outside portion of this warm air space are detachable, and may be taken off as occasion requires. When the carburetters are freshly charged, and when the air is very warm, there is a possibility of carrying too rich a gas down to the lamps; to obviate this difficulty, a permanent cross connection is made between the air inlet to and the outlet from the carburetter. In this cross connection is a diaphragm with a very small hole, so that a small amount of air is taken across to the gas as it comes out of the carburettor, diluting it a little, and thus preventing any possibility of too rich or smoky a gas reaching the lamp.

To make a system of this kind work satisfactorily, it was absolutely necessary that means should be devised for indicating when the carburetter needed recharging with gasoline. This is accomplished very neatly and effectually by a mercury column which indicates through the difference in pressure the supply of combustible in the carburetter. To prevent the accumulation of pressure beyond that which is regarded as necessary for satisfactory lighting and to regulate the flow of gas, a safety valve has been devised which consists of a tube of mercury, and made to act in such a way that the gas passage is freed or restricted according to the pressure of the air on the surface of the mercury. The regulator, indicator and safety valve are compactly combined in a single piece of mechanism, which is placed in the closet of the car and intervenes between the air supply and the carburetters. The air is not taken direct from the train brake pipe, but is passed into a reservoir which holds a supply at even pressure, uninfluenced by the fluctuations of tension in the train pipe. There are many other ingenious features about this system of car lighting which it is not necessary to describe.

Although a description of the apparatus is necessarily protracted, the system in its operation is remarkably simple, and the operating of it is within the grasp of trainmen of the most ordinary intelligence. Each carburetter has a burning capacity of 125 hours between chargings, so that this work would not have to be done more than once in about three weeks. The charging is done with a can designed for the purpose, having an ingeniously contrived neck which makes a gas-tight connection with the opening of the carburetter. Pipe connections between the charging can and the carburetter permit the gas in the carburetter to pass out while the gasoline is passing in. The arrangement of pipes inside the carburetter is such that when the carburetter is fully charged, no more gasoline passes in, although it may not have completely run out of the can. This filling can is the whole of the plant, besides that fitted to the car, necessary for operating this system of car lighting.

Any one who rides in the Pennsylvania railroad cars at night will readily admit that the Frost dry carburetter system supplies a most satisfactory means of lighting cars, and well lighted cars are something which add very materially to the comfort of travelers. We are informed that the experience of two years' use of the system has demonstrated that six lights, each of 40 candle power, is kept burning at an expense of three cents per hour.

Reception of Our Engineers in Europe.

The members of the American engineering societies who have gone to Europe at the invitation of the engineering societies of England have met with a most cordial welcome that must be highly gratifying to them and to their friends. They are being lionized in a fashion such as visitors seldom experience in any country. The distinguished treatment which our engineers are receiving in a country noted for the number and eminence of its own engineers is a pleasant indication that the merits, ability and achievements of American engineers are fully recognized by their British colleagues. An article which appeared in the London *Times* of June 14, on English and American engineers, gives fair expression to the spirit in which our friends have been received in England. The article concludes:

"The American engineers are the true children and heirs of their parents and predecessors in the old country. They have drawn their inspiration from England and applied it to the requirements and circumstances of America. There was a massive and monumental solidity about the work of the older English engineers which would have been impossible and inappropriate in the early engineering days of America. The land in which extempore railways and trestle-bridges were among the primordial requirements of advancing civilization presented very different problems to the engineer from that in which Robert Stephenson built the Menai Bridge and the High Level Bridge at Newcastle, and Brunel, with magnificent audacity, designed and constructed the Great Western Railway. The skill was the same, but its application was different in the two countries. Where American engineers were compelled to build for the day or the morrow, English engineers were able to build for the next generation and the next century. But the extempore skill of the American engineers has in turn modified the massive conceptions of their English brethren, and our modern structures, such as the Forth Bridge, though not less monumental and permanent than the works of Stephenson and Brunel, are largely influenced by American ideas and experience. The cantilever principle is borrowed from the United States, and is itself, if we mistake not, the product of American conditions of work and American fertility of invention and audacity of construction. Thus the genius and skill of each country supplements that of the other. We borrow from America and America borrows from us, and both are the better for the exchange. On the sea, however, our supremacy is unchallenged. The swift steamers which brought our engineering friends across the Atlantic were designed by English engineers and built by English shipwrights. Whether this supremacy is due to the native genius of Englishmen, or to the legislation which fetters the genius and chills the enterprise of Americans we need not inquire. The supremacy is indisputable and undisputed. It may be that even in this direction America may some day better our example. If soon, both countries will gain in the end by the friendly rivalry between them. The triumphs of the engineer are the common gain of the whole world. All may profit by them who have the wisdom to imitate and the skill to improve."

Mr. Mallet on Componnd Locomotives.

Mr. A. Mallet, the celebrated French engineer and the inventor of the first successful compound locomotive, writes us to the effect that we did not do him justice in the paper read before the New England Railroad Club on compound locomotives. He gives particulars to prove that his compound locomotives designed for the Bayonne & Biarritz were the first practicable engines of the kind ever put in service. Regarding the shortcomings of the Nicholson compound, he quotes the proceedings of the Institute of Mechanical Engineers as follows: "One of the engines tried was a goods engine of the largest size; the valves only were altered and the second cylinder was not enlarged. It was a temporary experiment. The other engine was a passenger engine, in which the second cylinder was made double the size of the other. In the continuous expansion engine the steam from the boiler is supplied only to one cylinder; a portion of it is expended with the second cylinder, which is of proportionately larger area, and it is there expended down to the fullest useful extent and then discharged into the atmosphere, the portion of steam remaining in the first cylinder being discharged as a blast at nearly the same pressure as in the ordinary engine. The economy, therefore, consists in obtaining from such a portion of the steam as can be spared from the blast the additional power of expansion remaining in it, which is thrown away in the ordinary engine."

In another letter Mr. Mallet says: "I am afraid you are not plainly acquainted with my compound locomotives. You say an important element of success will be due to the engineer who designs a compound locomotive with a simple, efficient and durable appliance for transforming the engine into direct acting or compound acting at the will of the man in charge." What you say is precisely the essential feature of my own system. All the two-cylinder compound locomotives designed by myself are fitted with a starting valve on the side of the smoke box, in one position of which the engine works compound, and in the other position with direct admittance of steam to the exhaust from both cylinders.

The first Bayonne & Biarritz engines, built in 1876, have now thirteen years of continuous working, and a total mileage of 1,000,000 miles, that is say, 200,000 for each engine, which seems to show that the appliances are of a durable character.

For more recent and larger engines, one of which is at the Paris Exhibition, instead of a slide valve, somewhat cumbrous, I use a box containing two valves on the same spindle, which, by automatic working directs the exhaust of the H. P. cylinder either to the blast pipe or to the receiver and L. P. cylinder.

By the use of these appliances in all the engines designed by myself, the period of direct exhaust of the H. P. cylinder is not, like in the Worsdell and Von Borries engines, performed during a portion of one revolution, but is worked in that way as long as convenient. Beyond the starting, the engine can be worked direct anywhere that it is necessary to increase the tractive power.

The officers and men in the mechanical department of the Union Pacific are making good use of our pamphlet on "Combustion in Locomotive Fire-boxes." The engineers and firemen are holding meetings to discuss the principles laid down in the work, and the master mechanics, at the request of the superintendent of motive power, have each formulated a catechism of firing with questions and answers based on the book. We are informed that the management of this road consider that they have already been well repaid for the expense incurred in supplying the pamphlet to their enginemen. The master mechanics of several other roads which have supplied their men with the pamphlet write very flattering reports about the influence the treatise has exerted for good with their engineers and firemen.

Six master mechanics connected with the New York, Lake Erie & Western, became members of the American Railway Master Mechanics' Association at Niagara Falls Convention. Mr. Ross Kells, superintendent of motive power of the road, was absent through engagements which kept him away, but he was very anxious to be present, and used his personal influence with his master mechanics to have them attend.

The Russian Department of Railways has offered to buy ten of the Leslie Rotary Steam Snow Shovels if the company making these machines will send one for trial and it should prove satisfactory.

Proceedings of the Master Mechanics' Convention.

The American Railway Master Mechanics' Association assembled in the 22d annual convention at Niagara Falls at 10 A. M. on June 18.

President J. H. Setchel, Pittsburgh Locomotive Works, occupied the chair. The proceedings were opened by the Rev. C. S. Stowitts invoking the divine blessing, after which President Sheldon, of the village of Niagara Falls, delivered an address of welcome.

Secretary Sinclair called the roll, and the following members were present at the Convention:

Thomas Aldcorn, West Shore, New Durham, N. J.
W. C. Arp, C., St. L. & P., Logansport, Ind.
W. Augustus, Keokuk & Western, Centerville, Ia.
J. Davis Barnett, Grand Trunk, Stratford, Ont.
John Bean, Cleveland & Canton, Canton, O.
John Bisset, W., W., C. & A., Wilmington, N. C.
Charles Blackwell, Highland, N. Y.
J. M. Boon, West Shore, Frankfort, N. Y.
S. D. Bradley, G. R. & Ind., Grand Rapids, Mich.
R. H. Briggs, K C., M & B., Memphis, Tenn.
F. R. F. Brown, Canadian Pacific. Montreal, Que.
H. S. Bryan, St. Paul, Minn.
R. W. Bushnell, B., C. R & N., Cedar Rapids, Ia.
John Campbell, Lehigh Valley, Delano, Pa.
N. E. Chapman, Philadelphia, Pa.
David Clark, Lehigh Valley, Hazelton, Pa.
Jno. W. Cloud, Buffalo, N. Y.
Allen Cooke, C. & E. Illinois, Danville, Ill.
John S. Cook, Georgia, Augusta, Ga.
C. H. Cory, C. H. & Dayton, Lima, O.
J. P. Dickson, Dickson Locomotive Works, Scranton, Pa.
D. J. Durrell, Rotary Snow Shovel Co., Paterson, N. J.
W. H. Eddy, Boston & Albany, Springfield, Mass.
W. C. Ennis, N. Y., S. & W., Wortendyke, N. J.
G. W. Ettenger, Iron Car Co., New York.
D. T. Evarts, Boston, Mass.
A. Fenwick, G. B., W. & St. P., Green Bay, Wis.
G. A. Ferguson, Lake Village, N. H.
Z. J. Ferguson, Mobile & Ohio, Jackson, Tenn.
F. J. Ferry, L., St. L. & Texas, Henderson, Ky.
Charles Graham, D., L. & Western, Scranton, Pa.
J. S. Graham, L. S. & M. Southern, Cleveland, O.
Fred B. Griffiths, D., L. & Western, Buffalo, N. Y.
Albert Griggs, P. & Worcester, Providence, R. I.
Clem. Hackney, Milwaukee, Wis.
George Hackney, A., T. & Santa Fe, Chicago, Ill.
B. R. Harding, R. G., R. & A., Raleigh, N. C.
T. A. Hatswell, F. & P. M., East Saginaw, Mich.
Wm. Hassman, R. & Alleghany, Richmond, Va.
John Hewitt, Wabash Western, Butler, Ind.
John Hickey, M., L. S. & W., Kaukauna, Wis.
M. L. Hinman, Brooks Locomotive Works, Dunkirk, N. Y.
S. A. Hodgman, Lobdell Car Wheel Co., Wilmington, Del.
E. W. M. Hughes, Fox Solid Steel Truck Co., Chicago, Ill.
O. H. Jackson, O. & Miss., Vincennes, Ind.
G. R. Jonghins, Erie & Huron, Chatham, Ont.
Sanford Keeler, F. & P. Marquette, East Saginaw, Mich.
C. F. Lape, Wabash, Springfield, Ill.
J. K. Lape, St. J., St. L. & S. F., St. Joseph, Mo.
J. N. Lauder, Old Colony, Boston, Mass.
L. F. Lyne, Jersey City, N. J.
Jacob Losey, Steam Forge Company, Louisville, Ky.
John Mackenzie, N. Y. C. & St. L., Cleveland, O.
James Macbeth, West Shore, Buffalo, N. Y.
J. S. McCrum, K. C., Ft. S. & G., Kansas City, Mo.
James McGlenn, Carolina Central, Laurenburg, N. C.
John McKenna, I., D. & S., Indianapolis, Ind.
John Medway, Fitchburg, Mechanicsville, N. Y.
James Meehan, C., N. O. & T. P., Cincinnati, O.
Thomas Millen, N. Y. City & Northern, High Bridge, N. Y.
Wm. Montgomery, Cent. of New Jersey, Manchester, N. J.
J. E. Morrell, C., R. I. & P., Davenport, Ia.
J. H. Murphy, N. Y., L. E. & W., Buffalo, N. Y.
L. C. Noble, H. & T. Central, Houston, Tex.
J. S. Patterson, Cincinnati, O.
L. B. Paxson, Phil. & Reading, Reading, Pa.
Peter H. Peck, C. & W. Indiana, Chicago, Ill.
J. E. Phelan, Northern Pacific, Mandan, Dak.
A. J. Pitkin, Schenectady Locomotive Works., Schenectady, N. Y.
Joseph S. Porter, C., S. & C., Sandusky, O.
G. H. Prescott, T. H., I. & St. L., Terra Haute, Ind.
T. B. Purvis, Boston & Albany, East Albany, N. Y.
L. S. Randolph, Cum. & Penna., Mt. Savage, Ind.
Geo. Richards, Roxbury, Mass.
E. Richardson, S. & Allegheny, Shenango, Pa.
E. M. Roberts, A., C. & I. Co., Ashland, Ky.
Geo. B. Ross, Buffalo, N. Y.
J. H. Setchel, Pittsburgh Locomotive Works, Allegheny, Pa.
W. A. Short, O. & L. C., Malone, N. Y.
Augus. Sinclair, Morse Building, New York, N. Y.
W. T. Small, Northern Pacific, St. Paul, Minn.
C. E. Smart, Michigan Central, Jackson, Mich.
W. T. Smith, N. N. & Miss Val., Lexington, Ky.
H. N. Sprague, Porter Locomotive Works, Pittsburgh, Pa.
S. A. Stephens, Rhode Island Locomotive Works, Providence, R. I.
O. Stewart, Fitchburg, Charlestown, Mass.
F. A. Stinard, Pompton Junction, N. J.
W. A. Stone, L. E. & St. L., Huntingburg, Ind.
Wm. Swanston, C., St. L. & P., Indianapolis, Ind.
H. Tandy, N. Y., O. & W., Middleton, N. Y.
Thos. Thatcher, D., L. & W., Utica, N. Y.
W. H. Thomas, E., T., V. & Ga., Knoxville, Tenn.
S. B. Tinker, C., W. & Mich., Wabash, Ind.
W. F. Turreff, C., C., C. & I., Cleveland, O.
T. B. Twombly, C., R., I. P., Chicago, Ill.
C. W. Walker, S. & Roanoke, Portsmouth, Va.
Amos H. Watts, Cincinnati, O.
Reuben Wells, Roger Locomotive Works, Paterson, N. J.
G. W. West, N. Y., L. E. & W., Jersey City, N. J.
M. C. Wheeler, Central Iowa, Marshalltown, Ia.
D. A. Wightman, Pittsburgh Locomotive Works, Allegheny, Pa.
John Wilson, Union Pacific, Omaha, Neb.

The following new members joined the association at this convention:

A. W. Ball, N. Y., P. & O., Galion, O.
J. N. Barr, C., M. & St. P., Milwaukee, Wis.
J. E. Battye, Shenandoah Valley, Milnes, Va.
Wm. R. Billings, Taunton Locomotive Works., Taunton, Mass.
Joseph Bradt, N. Y., L. E. & W., Rochester, N. Y.
T. Carmody, N. Y., P. & O., Cleveland, O.
Peter Curran, N. Y., L. E. & W., Bradford, Pa.
Alonzo Dolbeer, B., R. & P., Rochester, N. Y.
George Gibbs, C., M. & St. Paul, Milwaukee, Wis.
F. A. Givan, Ches. & Ohio, Huntington, W. Va.
J. L. Greatsinger, D., I. & R., Two Harbors, Mich.
S. H. Harrington, N. Y., L. E. & W., Susquehanna, Pa.
S. Higgins, N. Y., P. & O, Meadville, Pa.
W. J. Huller, Ches. & Ohio, Richmond, Va.
W. Lavery, N. Y., L. E. & W., Susquehanna, Pa.
W. H. Lewis, Ch., B. & North, La Crosse, Wis.
E. A. Miller, N. Y., C. & St. L., Conneaut, O.
J. H. Moore, N. Y., L. E. & W., Port Jervis, N. J.
J. C. Ramsay, Miss. & Tenn., Memphis, Tenn.
T. W. Ransom, N. Y., L. E. & W., Hornellsville, N. Y.
John Robinson, L. S. & M. S., Buffalo, N. Y.
H. M. C. Skinner, N. Y. Locomotive Works, Rome, N. Y.
Wm. J. Thomas, Nor. Pacific Coast, Sausalite, Cal.
Chas. C. Turner, W. N. Y. & Penn., Olean, N. Y.
L. H. Turner, Pitt. & L. Erie, Chartiers, Pa.
S. R. Tuggle, Kentucky Central, Covington, Ky.
Allen Vail, W. N. Y. & Pa., Buffalo, N. Y.

President Setchel delivered the following address:

LADIES AND GENTLEMEN: Again we meet in convention, and again it is my pleasant duty to address to you such words of welcome and encouragement as may seem fitting for the occasion.

At our last annual meeting we took the opportunity to try and show that the principle and object of the association was not so much to establish mechanical standards as to promote investigation of mechanical questions; and those of you who were present or who have since read the president's address, and have watched the interest taken in the formation of new railway clubs in all prominent railroad centers for the discussions of such questions, will, we think, admit that the position there taken has been fully sustained; for these organizations are but the outgrowth of this and kindred associations.

The chairman of committee in the larger association very wisely takes pains to have the subjects upon which they are to report introduced and discussed in the local clubs, that full information may be obtained for presentation at these annual gatherings. And without any disparagement to the plan of committee circulars and answers, we may say that the information thus obtained is of a far different character from that in the average answer to a committee circular. In the one case you have the limited practice with perhaps the theory as to probable results, in the other you have a summary of experience that largely proves the result. Indeed, so valuable have the proceedings of these clubs become that they form a large part of the technical reading on current mechanical topics of the day in the best papers of the country. And in the selection of such reading matter the press simply gives the public what it asks for—a summary of what is regarded as the latest and best practice in railway mechanics.

But it is a notable fact that sometimes what seems the best is faulty, and remains so for an indefinite length of time; but this does not come from an intelligent investigation of the subject, but rather from lack of such investigation. We do not know where we stand until we compare ourselves with our neighbors. Who has not been sitting in a railway train and imagined that a train on an adjoining track was standing still while his own was moving, until, casting the eyes upon the ground, the delusion is suddenly dispelled and we find that we are standing still and our neighbor is the one that is moving. So it is oftentimes in mechanics. We think we have the best, we are moving, but by comparing ourselves with others we find to our dismay that it is the other fellow that is moving and that we are fast falling to the rear.

As an illustration of the evolution of the locomotive in certain directions of construction and operating under association influence, let us take a few familiar examples.

We all remember how in the early days of railroading we used to throw away cylinders because of the valve seat being badly worn, and then how to obviate this we contrived to put on a false seat by using a large number of tap bolts that made an expensive job to begin with and often more so to maintain. Engines would frequently give out on the road and trains would be delayed from the false seats becoming loose; and the matter continued to receive the earnest attention of master mechanics until it was discovered that, really, these false seats required no fastenings at all, and a patent was actually obtained for this discovery. But only a little later on it was also discovered that the balanced valve would not only obviate the necessity for renewing cylinders or applying false seats, but would also enable the locomotive to do much more work with less wear upon the valve gearing, and this is now being generally adopted. In direct connection with this subject came that of lubrication for valves and cylinders. The time when no lubricant was used for locomotive cylinders and valves has been handed down to us by some of the older members, but the transition from the tallow-pot to the nicely adjusted sight-feed lubricator of the present is of so recent a date as to be remembered by all, and the benefits derived from these two improvements alone can scarcely be measured.

With the improved method for lubricating cylinders came the opportunity to cheapen the lubricator itself, and, instead of tallow and lard oil at one and two dollars per gallon, we now use a lubricant made by many of our leading railways costing less than thirty-five cents per gallon, and that works well in our sight-feed cups and gives better results in the cylinders than the expensive material of a few years ago.

The hemp packing in general use but a short time for pistons and valve-stems is fast giving way to the much better metallic packing. The old style piston-packing with its expensive rings and springs is replaced with the simple snap-ring and cast-iron heads.

The record of steel boiler plate from the early days of coal-burning locomotives, when sixty per cent. of the steel fire boxes fractured within a very short time after being put in service, to the steel that now lasts from five to twelve years, and from the boiler of 120 pounds steam pressure to that of 180 pounds of the present, is the history of this association. Never has it failed to have this subject under consideration, and each of the improvements named have year after year received the careful attention of committees. The defect of the present and the necessity for better service have been clearly outlined and the improvements made have been at the demand of the Master Mechanics' Association—thus doing for the railroads what individuals could not do by collecting and presenting to them the combined experiences of railway mechanics as to the best material and the practice of constructing it in the best possible manner.

What we have mentioned are but a very few of the many improvements that have been made as the result of the persistent investigations of this association. Much more might be said of what has been accomplished, but as with every effort to obtain knowledge new possibilities are constantly presenting themselves until what has been done seems but a drop in the bucket, and we turn our attention to new subjects and to what there is new in new subjects that pertains to the live future of railway mechanics.

The subjects that will be presented for your consideration at this convention are important and will deserve, as they no doubt will receive, your very careful consideration.

The first to be presented—"the purification of feed waters for locomotives"—is a subject that has occupied the attention of the association since its first organization. It is one that is closely connected with the life of the fire-box and boiler and the durability of the locomotive itself. It sometimes seems a debatable question as to whether the steel we now use in boilers is so improved in quality or whether it is the improved quality of the feed-water that has more than doubled the life of our locomotive boilers, while performing a largely increased amount of work. The purity of the feed-water largely affects the consumption of fuel, the one great question in railway mechanical economy that overtops all others, and one which this association is in duty bound to follow up to a termination of better results.

"The thickness of tire as affecting their durability" will be an interesting subject and will have advocates on both sides, and full discussion of the question cannot fail to produce good results.

This will be followed by the subject of "exhaust nozzles," which is one that, while it is often lightly regarded by some, continues to receive the attention of our best mechanics—a number of whom have made radical departures from the usual practice during the year, and some of which give promise of good results both in the working of the engine and also in the amount of fuel consumed by giving better combustion.

The subject of "driving boxes" is fourth in the list and has frequently been before you for consideration, but there still exists a variety of opinion as to the best metal for driving boxes as well as the best shape and method of fitting up. A number of good mechanics have used solid brass driving boxes and claim that—while it is expensive in first cost—the durability and great length of service these boxes give, and the fact that the old metal is worth nearly its full value when the box is worn out, more than compensates for the increased first cost. Under this head your committee will no doubt consider the subject of lateral motion for driving and truck boxes, as there seems to be an opinion prevailing among some of our best mechanics that this work is being fitted up too close.

The fifth question of "boiler covering," the seventh the "best proportion of grate and flue area," and the ninth "water space around fire boxes and flues," all point to and have more or less to do with the fuel question.

We must get a larger per cent. of the heat from our fuel and as far as possible prevent any unnecessary radiation.

The eighth question, which includes a suitable form of mud rings and method of fastening, is but little behind those we have mentioned in its influence on fuel. All leaks in fire box or boiler detract from its steaming qualities, and no part leaks so often or continues so long as the mud ring of the fire box.

The questions are all important, and if full justice is done them in discussion this will be a busy convention.

At our last annual meeting you will remember we adopted a new constitution and by-laws, which will govern the deliberations of this body.

Under the provisions of this instrument the writer was unanimously appointed custodian of the Boston fund. This you will see by referring to last report consisted of a principal in 4 per cent. government bonds.

Boston fund, principal	$6,200.00
Interest for same on present year	248.00
Interest remaining over for last year	22.13
Leaving a balance of uninvested interest of	$270.13

This will be invested as may be directed by the executive committee.

Notice was given last convention of an amendment to be offered at this time in regard to nomination of officers. There should also be notice given at the proper time of an amendment fixing the amount of initiation fee for new members, as this has been omitted entirely in the new constitution.

With characteristic energy the secretary had the reports printed and distributed to members early in the year. A reprint has also been made of the fourth annual report, which is now ready for distribution.

There has been a large contribution to our printing fund, and our financial condition is exceedingly good.

For a detailed report of the above you are respectfully referred to the full and able reports of your secretary and treasurer.

With a wish for your kind consideration for myself, as I shall attempt to preside over your deliberations, I now invite you to the business of the convention.

J. H. SETCHEL, President.

An adjournment of five minutes was then taken for new members to sign. On reassembling, Secretary Sinclair read his report, as follows:

SECRETARY'S REPORT.

When the last annual convention met this association consisted of 297 ordinary members, 13 associate members, and 12 honorary members. The number of members on the roll at the present time is 332, being made up of 307 ordinary, 12 associate and 13 honorary members. During the year 27 new ordinary members and one associate member were added to the roll, and one ordi-

nary member was elected to the list of honorary members. Among the changes in the roll, two ordinary members and one associate member resigned, 13 ordinary members and one associate member have been dropped for non-payment of dues, and two ordinary members, Mr. S. Haines and Mr. George C. Watrous, have died.

The annual report containing the proceedings of last convention was delivered to members in the middle of August, and is a volume of about the usual size. Sixteen hundred copies of that report were printed; 1,216 copies have been disposed of in the usual way, leaving a good supply for future needs. A resolution was adopted at last convention recommending the reprinting of back numbers of the annual reports, which were out of print. In compliance with that resolution 700 copies of the fourth annual report have been printed. There appears to be a growing demand among scientific societies for full sets of annual reports of this association.

During the course of the year numerous circulars and communications have to be sent to the members of this Association, and it is very desirable that your secretary should have the correct address of every name on the roll. The exigencies of railroad service make changes of location numerous, but it is very rarely that a member thinks it necessary to send notice of change of address. Your secretary would request that members give their co-operation in maintaining a correct address list.

A list of the names of subscribers to the Printing Fund was given, and the following is the account of money received:

Total receipts for printing fund	$942.00
Receipts from dues and initiation fees	1,493.00
Receipts from sale of reports	40.00
	$2,475.00

ANGUS SINCLAIR, Secretary.

This was followed by the treasurer's report, as follows:

TREASURER'S REPORT.

	June 18, 1889.	
Cash on hand as per last report	$735.25	
June 21, 1888—Received A. Sinclair, secretary	651.00	
June 17, 1880— " " "	1,824.00	
		$3,210.25
June 21, 1888—Paid A. Sinclair, secretary, salary	$1,200.00	
June 21, 1888—For rink at Alex. Bay	25.00	
June 28, 1888—Reporting	131.37	
J. M. Allen	6.00	
McGowan & Slipper, printing	49.45	
Donnelly & Sons, printing	170.30	
" " "	431.36	
Geo. B. Benedict, engraving	109.95	
Transportation	1.87	
Charles Star, printing	2.25	
Insurance	8.00	
Expense of secretary's office	106.68	
		2,302.23
Balance on hand		$908.02

GEO. RICHARDS, Treasurer.

Some routine business having been transacted the noon hour arrived and President Setchel intimated that the regular order of business was the discussing of topical subjects.

Secretary Sinclair announced that the first subject for discussion would be introduced by Mr. O. Stewart, and was on

BURSTING OF STEAM CHESTS.

Mr. O. Stewart, Fitchburg Railroad, had investigated the causes that led to the bursting of steam chests, and he was convinced that structural weakness did not account for many of the accidents that happened to this part of the engine. Found that steam chests were often burst by the reversing of an engine immediately after oiling the valves. Believed that a gas was produced by the oil in the hot cylinder which caused rupture in the shape of an explosion. Believed there was little danger of the steam chests bursting when the engine was reversed if it was not done when there was considerable fresh oil in the cylinder.

Mr. J. N Lauder, Old Colony, believed that there was no more mystery as to the cause of steam chest explosions than there is with boiler explosions. The cause was weakness due to poor material and weak design.

Mr. John Mackenzie, New York, Chicago & St. Louis, mentioned that when he was running a locomotive and had to reverse the engine to prevent a collision, he had seen the steam gauge indicate very rapid increase of boiler pressure. This was due to the air rapidly pumped in by the cylinders.

Mr. Lauder thought the throttle valve now used, which is not opened by pressure applied from the steam chest side, might lead to over pressure in the cylinders when an engine was reversed unless the throttle was opened a little.

Mr. Stewart insisted that an engine might be reversed and the wheels made to turn the wrong way without danger to the cylinders and the steam chest, unless it was done immediately after oiling the valves. Why is an accident likely to happen then?

Mr. L. F. Lyne spoke of mixtures of gases that explode spontaneously, and he thought these might be generated in the cylinder. Referred to explosions of gas that had happened in the electric conduits of New York, where no spark could have been present to fire it. Also told about explosions that have resulted from the accumulation of gas in marine boiler flues.

Mr. James M. Boon, West Shore, expressed the opinion that a properly designed steam chest made of good material never bursts.

Mr. Angus Sinclair, NATIONAL CAR AND LOCOMOTIVE BUILDER, did not believe that oxygen and hydrogen gas would be separated from the steam in the cylinders. The gas compressed in the cylinder when an engine is reversed is atmospheric air, and if an explosion of a steam chest happens when the engine is reversed it is likely caused by overpressure of that compound. Thought that most throttle valves permitted the compressed air to pass into the boiler, for he had frequently taken indicator diagrams from engines reversed and did not find any excessive pressure. Believed rupture of steam chests to be nearly always due to weakness.

Mr. George Gibbs, Chicago, Milwaukee & St. Paul, said that the volatile gases from lubricating oils formed a very explosive mixture. Thought it likely that compressing the air and gases in the cylinders might raise the temperature sufficiently high to ignite the gases and cause explosion.

Mr. Peter H. Peck, Chicago & Western Indiana, suggested that a red hot spark drawn in by the suction of the piston might ignite the gases. His opinion was, however, that the bursting of steam chests was due to weakness alone.

Mr. John Wilson, Union Pacific, did not believe that any part of the locomotive had been habitually so badly designed and constructed as the steam chest. "With a new design, properly constructed and properly designed, we would have no more of the troubles. It makes no difference whether it is an explosion or an overpressure. I do not blame lots of steam chests I have seen for bursting. I would have burst myself had I been made the way they were."

Mr. Stewart was not disposed to take the explanation of the last speaker. Believed that four times out of five a steam chest will be burst if the engine is reversed immediately after oiling, and he could not attribute that to ordinary weakness.

Mr. Mackenzie asked if explosives of that kind happened when automatic cylinder lubricators were used.

Mr. Stewart answered that they did not. They only happened after a considerable quantity of oil was poured into the cylinders by the old method of oiling.

Discussion closed.

Next subject taken up was

DIMENSIONS OF AXLE FOR HEAVY TENDERS.

Mr. W. H. Lewis, Chicago, Burlington & Northern, favored the establishing of a new standard axle sufficiently heavy to withstand the shocks of any service put upon it, and still have it of dimensions that would conform to our present M. C. B. standard oil-box. Believed it would be a measure of great economy to adopt a new standard that would cause no change of dimensions except in wedge and bearing. He offered an axle that fulfilled these conditions. The journals are 4 × 8 inches; dust guard, 2¼ inches long; distance between centers of journals, 75½ inches; total length of axle, 84¾ inches.

Mr. Lauder favored a collarless journal like the Johann arrangement, but he had found that the stop wedge did not work satisfactorily in a diamond truck, as the whole strain of a side shock had to be resisted by one side of the truck. Spoke highly of the Bemis box and axle. Hoped when they were making a change that the master car-builders would adopt something heavier than a four-inch journal.

Mr. James Meehan, Cincinnati, New Orleans & Texas Pacific, had tried several axles with collarless journals, and found that the box designed by Mr. W. H. Thomas, of the East Tennessee, Virginia & Georgia to control the thrusts of a collarless journal, gave the greatest satisfaction.

Mr. GIBBS: I have prepared some figures to bring forward to the M. C. B. convention on this subject. It seems to me a pity in view of the fact that the master car builders are going to discuss this question that it could not be one of the questions for us to discuss. We have thought somewhat of using a heavy axle ourselves on our 2,600 gallon tanks. We have had no difficulty with the smaller axle, but we believe in having a larger diameter and keeping the length the same.

Mr. Sinclair thought it would be perfectly in order for the association to discuss the subject, and moved that its consideration be postponed to the noon hour to-morrow. Carried.

PURIFICATION OF FEED WATER.

Time for resuming the regular order of business having arrived, the report on the above subject, which was first on the list, was called up. Secretary Sinclair announced that no report had been received. He read the following letter on the subject from Mr. Wm. Wilson, superintendent machinery, Chicago & Alton Railroad:

We have had in operation since Oct. 30, 1888, what is called Smith's feed-water purifier and heater on locomotive No. 5 on our Dwight Branch. Water on branch is very bad. Cannot run an engine there three weeks before flues need tinkering and life is about five months. Engine has to be washed out at least three times per week or water foams so bad we cannot run her. No. 5 ran 66 days at first with no change of water. At end of that time water was clear, no foaming nor raising, and her flues are good to-day. I call your attention to this that you may bring it before the convention.

Secretary Sinclair then read the report on

TIRES.

The committee appointed at the Alexandria Bay Convention in 1888, to investigate the subject of "Tires; Advantage, or Otherwise of Using Thick Tires," beg leave to submit the following:

Circulars were issued to members, containing a series of questions, to wit:

First.

Please furnish a tabulated statement showing mileage made by a series of heavy and light tires of the same make, upon a form similar to the one inclosed.

The statement given herewith shows the average mileage made per sixteenth inch wear of tires of the same brand and thickness under engines of the same type, weight, size of drivers, etc. It was hoped that the members would liberally comply with this request by showing the performance of a large number of engines of the same class, which would tend to make better averages of varying materials of the same brand, as well as the average handling by a large number of different men.

Of the nine statements at hand, only the Chicago, Burlington & Quincy, and the Chicago, Rock Island & Pacific roads show comparisons between tires of 3 and 4 inches in thickness.

Both of these result, however, in favor of the 3-inch tire, showing for them average increased mileage per unit wear of about 20 per cent. In general the reports received are rather conflicting, and it can scarcely be said that there is any difference in the wearing qualities of the material in the outer rim, inner rim, or inside center core of the same tire. In comparing the mileage of tires varying from 2¼ to 3½ inches original thickness, the thinner ones have averaged a trifle better, although in many cases the thicker ones gave very good results.

Second.

Can you give any figures showing the amount of wear to tires occasioned in handling engines by different engineers?

This question was intended to bring out, if possible, something more definite in regard to the influence the engineer exerts on the wear of tires.

At the last convention it seemed to have been almost a unanimous feeling that the engineer was greatly responsible for the condition of his tires, and of those who expressed their ideas in figures, the lifetime of a tire might be increased from 25 to 100 per cent. by careful handling. The only figures given in answer to this question are by the Illinois Central Railroad. The comparison made gives the mileage of three engines in suburban service. These engines are of the "Forney" pattern, built at the same time and to the same drawings. They are equipped with driver-brakes with the plain shoes, and have the same brand of tires 3½ inches thick. The service is such that each engineer makes the same number of trips over the same part of the road each day with the same number of cars, stopping on an average of every two minutes. Every precaution was taken throughout to make all the circumstances and conditions connected with the running of these engines alike.

The engineers, all of whom are good, conscientious men, were notified that a comparative record of their tires would be kept, and each man was to do his utmost to make a large mileage. The following is the result to date: The first engine made 103,618 miles to $\frac{14}{8}$ inch wear of tire, an average per unit wear of 7,400 miles. The second made 111,345 miles to $\frac{24}{16}$ inches wear, an average per unit wear of 4,635 miles. The third made 112,455 miles to $\frac{26}{16}$ wear, an average per unit wear of 4,243 miles The average of the remaining 14 engines of the same type and service was less than the the third case above mentioned.

Third.

Do not heavy wheel centers with thick tires produce flat spots upon the tread of tires much sooner than light wheel centers with light tires? If so, please send statement showing the difference.

On account of the meager information received to this question, the committee is unable to give any figures on the subject. We recommend, however, that a wheel center of sufficiently heavy design to safely carry load and resist shocks and strains be used, and that the same be counterbalanced as perfectly as possible.

Fourth.

To what extent does the condition of tires influence the taking of an engine into shop for general repairs?

A large majority of answers to this question were, that the condition of tires directly governed the time between repairs of engines.

Fifth.

In determining the advantage of a thick over a thin tire or vice versa, do you take into account the expense of turning tires?

It has been claimed by many that a thick tire is cheaper or better on account of the lesser percentage of material scrapped after being worn out and the consequent increased percentage used in wear.

All other things being equal, and taking into account the original cost, crediting this with the scrap after tire is worn out, a 4-inch tire will cost 10.9 per cent. less per thousand miles run than a 3-inch tire.

Sixth.

What is the cost at your shop of disconnecting an engine, taking out wheels, turning tires and replacing wheels ready for service?

This amount varies from $14.50 to $37. As a rule the condition of tires causes an engine to be taken into shop when otherwise she would have made in many cases from 20 per cent. to 50 per cent. more mileage before requiring repairs to machinery, but being in for tire turning, and different parts of the machinery taken down, it is generally considered advisable to do a limited amount of work to the machinery, so that it will not be necessary to hold the engine for this work before she comes in again for tire turning, and it is safe to say that quite a large proportion of the expense of repairs to machinery is directly caused by tire wear.

Seventh.

In conclusion, state the reason why you think a thick tire better than a thin one, or vice versa.

Though the records of wear of thick and thin tires received could scarcely be taken as a general average, it is all the committee have to consider. This wear showed about 20 per cent. more mileage in favor of the 3 inch tire, whereas, in comparing the cost, we find the 4 inch tire is 10.9 per cent. cheaper than a 3 inch tire. Now, with all the other influences incidental to tire wear, such as use of sand, slipping drivers, use of driver-brake during the same period, the fact that one set of tires will do much better than another set of the same brand and thickness under the same engine handled by the same engineer, the diversity of opinions of the members of this association, the committee find it very difficult to say with any degree of certainty which of the two is the better.

Undoubtedly the best and most economical tire for railroad purposes is the one making the greatest mileage per unit of wear. A greater service from the engine is thus obtained on account of fewer interruptions to business, with a corresponding decrease in repairs to engine, but to determine to a certainty the original thickness or the physical condition of the metal to perform this mileage is a problem requiring much more definite data.

The Illinois Central has prepared a statement showing the performance of 252 sets of tires of the same brand, varying from 2¼ to 3½ inches in thickness, in all kinds of service. The total mileage was 45,698,728 miles, and the total wear 3,988-sixteenths, an average of 11,459 miles per unit of wear. Another statement shows the performance of 33 sets of tires of another brand varying from 2¼ to 3½ inches in thickness, all but two sets having been in passenger and freight service. The total mileage for these was 5,087,042 miles, and the total wear 621.5-sixteenths, an average of 8,185 miles per unit wear. Although the original cost of the former was 7¾ cents per pound, and the latter 5¼ cents per pound, a difference of 32.2 per cent., the cost per 1,000 miles run of the former was 12.78 cents and the latter 12.19 cents, a difference of only .59 of one cent, and taking into account that the cheaper tire required to be turned five times, whereas the former only required four turnings during the same period, aside from losing the service of the engine during the fifth turning, it will be seen that the former is considerably the cheaper tire, although at a great difference in original cost.

Through the kindness of Mr. J. N. Lauder, we append hereto a paper on "Tire Metal," prepared by Mr. J. E. Howard, Engineer of Tests at Watertown Arsenal, as follows:

SOME NOTES UPON TIRE METAL.

At the Twentieth annual Convention, Mr. J. N. Lauder presented the results of some tests made at the Watertown Arsenal, upon the tenacity, hardness and density of two sections of 3-inch and 4-inch Midvale Steel tires. These results, it will be remembered, showed the two sections to have had nearly the same physical properties.

"At the request of Mr. Lauder, I have the honor to present a few remarks touching upon some of the questions involved in the general discussion of tire metal.

"The durability of a tire obviously depends upon the quality of the metal and upon the conditions of service.

"It is a comparatively simple matter to ascertain what the primitive qualities of a metal are and the information derived

possesses great value because it would seem if the relations between the physical properties and the effects of certain conditions of service were once definitely established that the physical examination would thereafter serve as a guide to identify what constitutes good tire metal. Before these relations are established, information from independent sources is desirable to obtain and naturally possesses more or less interest.

"In considering the influence of physical properties upon the durability of a tire we have to consider—first, the elastic limit of the metal. If the elastic limit was never exceeded obviously no wear would occur, for the particles of the metal would not be displaced beyond the limits of recovery and immediate restoration would be expected upon the release of load. If, however, the elastic limit is exceeded either throughout the entire section of metal or locally a permanent set results; some parts are forcibly moved to new positions, and if the process is repeated, rupture eventually ensues. In case local disturbance was alone received only a small portion may rupture, and it is then said that abrasion or wear has taken place.

"The behavior of the metal between the elastic limit and the time of rupture will depend upon attendant circumstances. Under a gradually increasing load large ductility may be developed, and on the other hand repeated loads may cause rupture with almost absolutely no display of ductility. Between these extremes varying degrees of ductility may be developed. If an exceptionally high load could never be received it would be logical and consistent to prefer a metal of the highest attainable elastic limit, but such a metal under no circumstances would have much ductility. Until further experience has been gained it seems the part of prudence to employ for most purposes a metal which is capable of displaying ductility, although the conditions of service may not render such display at all times possible, and with ductility the metal should of course have a good elastic limit and ultimate strength.

"In a homogeneous metal the tensile strength is substantially the same in any direction it may be tested. The metal may also resist loads acting in different directions at the same time, and further if a load is applied in one direction we may avail ourselves of the strength of the metal in different directions to assist resisting it. A practical application of this idea is found in the employment of a grooved form of tensile bar and convex surfaces under compression or where the pressure is applied to only a part of the surface. In the grooved form of tensile bar the actual cross section of metal resists the stress, and the lateral metal supports the net section by reason of lateral cohesion. Under compression, if only a part of the surface received the load, that part is reinforced by the surrounding metal and higher resistance results than due to the resistance of the metal in one direction. In connection with this behavior of the metal comes the query—what would be the ultimate resistance under compression if the lateral support was sufficient to entirely prevent flow? In experiments on cubic compression it has been found that ductile steel is capable of resisting an hydrostatic pressure of 90,000 to 117,000 pounds per square inch without any apparent change in tensile or compressive qualities. The bearing which these facts have upon the question of maximum allowable wheel or tire pressures will be clearly seen. The shape of the rail head and tire are both important as regards the amount of surface in contact and the amount of reinforcement given the contact surfaces by the adjacent metal. From this point of view it may be seen why it is practically a very difficult matter to so proportion the shape of these surfaces that maximum efficiency shall result.

"The presence of sand between the tire and rail occasions intense local compression, and may, and no doubt does, cause stresses exceeding the elastic limit of the metal of both the tire and rail. The elastic limit of rail and tire metal commonly exceeds the crushing strength of the rock used for building purposes. Exceptional strength has been met in the case of granular quartz, where a resistance of over 50,000 pounds per square inch has been found. Considering the ultimate crushing strength of the particles of sand and grit and the fact that more or less of their substance remains between the tire and rail tending to cause unequal distribution of load, it was thought sufficient to explain the manner in which the resistance of the metal may be overcome and thereby account for the extra wear of the tire and rail under such circumstances.

"Concerning the effect of reversing the stresses in iron and steel, direct experiments have shown that stresses exceeding the elastic limit cause serious disturbance and the indications point to the conclusion that alternate stresses are more detrimental than stresses in one direction only, provided in each case the primitive elastic limit is exceeded.

"Such being the case, we should infer that frequent reversals in the direction of running would be a cause of increased tire wear, and drivers with brakes, in addition to the direct abrasive action, would experience a difference in abrasive action against the rail when the brakes were applied over the period when they were not applied. When driving, the tendency of the driver is of course to slip one way, but when the brakes are applied the tendency is virtually to slip in the opposite direction although the driver continues to rotate in the same direction as before, and thus is introduced the effects of alternate stresses, in a measure, yet without actual reversal of direction. Furthermore, it will be seen that when the brakes are set the tendency of the brakes is to abrade or grind off the metal in one direction while the tendency of the rail at the time is to grind it in the reverse direction, and thus we have practically reversed stresses at each rotation of the driver while the brakes are in action.

"Inasmuch as intense heat is generated between the brake shoe and tire, sufficient to ignite particles of metal, one of two things might happen; either the rapid chilling of this heated surface by the adjacent metal might harden the surface, or if the abrasive action of the rail came while the metal was at a high temperature, increased abrasion might be expected by reason of the loss in elastic limit which the metal experiences while hot. The point just raised suggests the query whether abrasive action of the brake-shoe is appreciably different according to its position in front or behind the wheel. If in front, very little time elapses during the transit of the metal from under the brake-shoe to the rail, but relatively considerable time intervenes if the brake is behind the wheel.

"Considering the effect of speed, assuming the magnitude of the stresses unchanged, it appears from experimental research that steel may be loaded and unloaded at least at the rate of one-fortieth of a second without the effect being unlike slow loading provided the loads are kept within the elastic limit. If, however, the loads exceed that limit the metal does not respond in its elasticity as before a rapid increase of temperature following. With means at hand for dissipating the heat it would then seem that increased speed might tend to diminish abrasion. This result is reached when other features are eliminated, but it would seem under the actual conditions of service of a tire that the intensity of the stresses might be so much increased at high speeds as to entirely overcome the favorable features and result in a decided loss instead of gain. In the track complicated conditions are met, some of which conditions we learn from direct experiments have favorable tendencies and others are unfavorable. If the effect of high speeds could be considered only in relation to the sudden displacement of metal, all other features being eliminated, increased tire resistance against wear might be expected. Although we cannot accept any such premises in the practical consideration of the subject, yet an understanding of the elementary features materially assists in locating the true causes of abrasion and wear.

"The elasticity possessed by the tire, the wheel center, the rail, tie and finally road-bed, all have an influence upon the tensity of shocks incident to high speed. Under direct loads the tire and rail metal have about the same rigidity and are more rigid than the other mentioned. Tires differing in thickness would of course differ in relative rigidity."

This part of the subject admits of direct track observation.

This report throws considerable light on the subject, bringing forth various conditions under which the metal is strained to produce wear, but it also adds new complications to be solved before a definite decision could be reached.

The committee, however, concludes, taking into consideration all the circumstances and conditions of the report, as well as personal observations not mentioned herein, that they cannot see any benefit or advantage to be derived in using thick tires.

We therefore recommend to the members of this Association that tires 3 inches in thickness, of the best quality of material, would be the best and most economical for railroad purposes.

We take this opportunity to thank those members of the Association who have kindly contributed to this report, and make special mention of the kindness of Mr. J. N. Lauder, through whom the paper on tire metal was secured. Respectfully,

HENRY SCHLACKS, Chairman,
C. E. SMART,
J. W. STOKES.

No discussion followed the reading of the above report.

Next business was the reading of the report on

DRIVING AND ENGINE TRUCK BOXES.

Your committee on "Driving and engine truck boxes, best form and material, including journal bearings and manner of fastening same in box" would report that they found these subjects had been pretty well covered in a report to the association at the Washington meeting. Driving boxes are made of cast iron, cast steel, bronze and brass. When made of strong, close iron of good design, cast iron will give good results. In many cases where cast iron is used, the box is not properly proportioned from a desire to use the same size pedestal and box as used for lighter class of engines, or using a larger driving shaft, the box is reduced and made too light, and breakage is the natural result. The weight of locomotives is steadily increasing, yet it is not unusual to find a driving box on an engine weighing 50 tons but little heavier than one for a twenty-five or twenty-eight ton engine. This is one cause of driving boxes breaking. Another is from the desire to have as wide a fire-box as possible; the frames are thrown out, space reduced between frames and hub of driving wheels, making light flange on driving boxes, broken flange the result. When the fire-box is set on top of frames another trouble develops, that is, the danger from hot boxes caused by the cinders and ashes falling from fire-box into driving boxes and bearings, causing them to heat.

Practice has shown cast steel to be an inferior metal for driving boxes; it being a stronger metal than cast iron, weight can be reduced in castings, which is about the only merit it possesses. The most serious objection t is, that it wears badly when in contact with cast iron, as it must be with inside hub of driving-wheel, when, not only the box wears rapidly, but also the hub.

Your committee has knowledge of 30 engines with cast steel driving boxes, on which the hub and boxes had worn in two years so much lateral motion that ⅛-inch liners had to be fastened to the boxes. These liners were made of cast iron and brass; the cast iron was found to wear well and gave the best results. At the same time these boxes and hubs were wearing, 70 engines built from the same plans with cast iron boxes gave no trouble, and after five years' service had not worn lateral motion enough to need taking up.

Another objection to cast steel is, that the metal expands at a low temperature. A bearing becomes hot from some cause, the heat will expand the box more than the brass, which will (if circular shell pressed into box) become loose and necessitate tightening up. Bronze and brass, being alloys of copper, will be treated as one metal. There are but few driving-boxes made of these metals in this country. In Europe it is the rule to use them—they are the best metal for the purpose. Your committee are of the opinion that the coming driving-boxes will be made of these metals, solid bored out to fit the shaft. The thought of the cost of the bronze or brass over cast iron may at first be startling, but it is likely to prove economical, when it is taken into consideration that the patterns can be made lighter than for cast iron, the slotting out for bearing and fitting of same saved, the planing, boring and fitting will cost no more than cast iron, and the box will wear until worn through at the top, or so light as to be unsafe, the loss from wear of bearing will be no greater, and there will be a saving of tightening up old and fitting new bearings.

When the box is finally worn out, the credit for scrap will make a considerable reduction on cost of new box. The objection might be urged that in case of a hot journal the box might be ruined; extreme cases like this rarely occur.

Where bearings had been cut off roughened, it could be re-bored same as is now done with separate bearings. The form of bearing now generally used is the half round shell, the tendency of these bearings is to become loose, the shape of the bearing and the strain it is subjected to contribute to this end. The weight on the crown of the brass and wear on inside naturally causes the lower ends to close in away from the box and binding on the journal, causing heating and pounding of bearing in box.

The weak point of these half round bearings is the lower edges, which take the pressure in forcing bearing into box; these edges seldom have over three quarters inch bearing, and it is not unusual to see them not more than ¾ inch.

As the shells are forced to place in the box, with from 20 to 30 tons pressure, it will be readily seen that with this inadequate bearing on the edges, it is impossible to keep shells tight; a width of one and one quarter inches would scarcely be sufficient. They are not made heavier because the driving box is not wide enough to admit of cutting out, it would be weakened too much. After these shell bearings are finally in place we have no confidence in their remaining; we put a couple of ¾ or ⅞ pins through the box and shell to hold in place, further weakening the box with the holes, which in conjunction with the driven pins make a good starting for a fracture. A better shape in every way for journal bearing in driving box is what is known as the hexagon; this form can be fitted into the box without pressure; having no strain on the box it can be made lighter than the shell, and yet have more metal at the bearing points; by casting lugs on the top angles seven-eighths or one inch wide on bearing and corresponding recesses in the box, it is held to place with no further trouble. The cost of properly fitting this bearing in is more than the shell bearing, and final result is more satisfactory.

If the half round bearing is to remain as a fitting of locomotive driving boxes, a radical departure will have to be made in increasing width of pedestal openings to admit of wider boxes and heavier bearings which have got out of proportion to the heavy engines, larger driving shafts, higher boiler pressure and greater speed of modern practice.

Your committee are aware that there are other forms of driving-boxes with brass and cast-iron gibs; as there are but few, and those going out of service, have not discussed their merits. At present the journal bearings of driving boxes are made from bronze and brass. Those who are using bronze speak highly of its merits as a bearing. Those who are using brass are equally sure it is the best metal for the purpose. There are no records to show which of the two metals is actually the best for the service, and gives the best results. There are a number of mixtures for brass of driving-box bearings; those in use by roads of the largest mileage are as follows: Three, 6 parts of copper to 1 of tin; one, 6 parts of copper to 1 of tin, quarter pound of spelter; one, 7 parts of copper to 1 of tin, adding one-quarter pound lead; two, 7 parts of copper to 1 of tin; all report good results from these bearings. It is generally accepted that good results are obtained from hard bearings; but as the bearing is hardened, the danger of breaking increases; if the bearing is soft, they crush out.

Your committee are of the opinion that no fixed rule can be given for proportion of parts in brass used in driving shaft bearings for all classes of locomotives. The mixture must be proportioned to the weight carried. Engine truck boxes made of cast iron will answer every purpose. The journal bearing should be of hexagon pattern fitting freely into the box.

Such good results are obtained by casting the bearing, that no fitting is necessary. The reason of this is, that the weight now carried on engine trucks of the heavy four wheel or American class of locomotive is so great that truck may spring from shocks due to high speed. If shell bearings are used with close fitting boxes, heating is sure to result; when the bearing is loose in the box it will remain on the journal, and not be affected by the spring of the truck frame and braces. The hexagon truck bearing is fastened in box by lugs cast on angle on top side of bearing, which fits into corresponding recess on the inside of truck box. The general practice is to make these bearings of brass; some roads use bronze. The composition where brass is used on roads of large mileage is as follows: One, 7 parts of copper to one of tin, and one quarter pound lead; three, 6 parts of copper to one of tin; one, 7 parts of copper to one of tin; one, 9 parts of copper to one of tin; one, 6 parts of copper to one of tin, and one quarter pound of spelter.

All report good results from these compositions.

Your committee are of the opinion that the difference in the composition is due to the weight carried; where increased proportion of copper is used the weight is probably light; the copper is reduced as the weight increases; the committee have no information as to these weights. Brass bearings lined with lead give good results when weights are not excessive. It has been found that with 28,000 and 30,000 pounds on truck, the lead will crush out at the ends and sides of bearing; this can be overcome by adding tin or antimony to the lead; when this is done the metal becomes brittle and shells off. In case of hot journal, the lead melts, filling up the oil-holes and cavities, making it impossible to get oil to the journal, resulting in trouble and delay. Strips of Babbit metal one inch wide extending the full length of the bearing give good results, running cool and increasing the life of the bearing.

Your committee have not attempted to give dimensions or go into details, as there are now so many different classes of locomotives in service, working under ever varying conditions, which must be met and provided for, and cannot be governed by fixed rules covering all classes and conditions.

They hope that this report may be suggestive and bring value to the Association.

Committee, { WM. BUCHANAN, JNO. W. CLOUD, J. M. BOON.

Mr. Boon spoke against the use of the ordinary shell brass, and considered it to be a very unsatisfactory bearing to put in locomotive driving boxes. He found the hexagon-shaped brass much better. Described the troubles that followed the use of steel driving boxes, and advocated the use of well-designed cast-iron boxes with hexagon bearings of solid bronze boxes. In regard to truck boxes, he considered it a good plan to use a brass that would readily adjust itself to the twistings of the journal.

Mr. Lauder spoke of the preferences of people for brass or bronze. Held that very much depended on the work of the molder in the production of a bronze that would wear well as a bearing.

Mr. William Swanston, Chicago, St. Louis & Pittsburgh, preferred the hexagon brass, although they used the circular shell.

Mr. John Hickey, Milwaukee, Lake Shore & Western, favored the use of brass gibs, set into the box, and the spaces between filled with babbitt metal.

Mr. A. Cooke's experience with the hexagon brass had not been

satisfactory. They got loose and caused pounding. His favorite was the round brass forced into place by a pressure of about nine tons.

Mr. Sinclair spoke of the success that certain roads had met with in using solid brass driving boxes.

Mr. H. N. Sprague believed that brass boxes would lead to trouble from end play sooner than cast iron.

Mr. Lauder said that the lateral wear was very much less with cast-iron than with any other metal. Believed a well-designed cast-iron driving box to be better than any other.

Mr. Mackenzie said that they were having so much annoyance from the flanges of cast-iron boxes breaking that he intended trying steel. Thought the rapid lateral wear was due to want of the necessary clearance.

Mr. Lauder admitted that the old fashioned driving box with brass gibs had the merit that there was no danger of spreading the box in fitting it up.

Mr. Fred B. Griffiths, Delaware, Lackawanna & Western, said that they have a class of engine with the springs hung beneath, and cast-iron driving boxes were found to be too weak. Solid brass boxes were found too expensive, and they tried steel with satisfactory results. They countersink a brass collar in these boxes and find that they wear well. Attention is paid to keeping the rubbing surfaces lubricated.

Mr. J. S. McCrum, Kansas City, Fort Scott & Gulf, said that he uses babbitt metal in taking up lateral wear and finds that the plan works well. If he were to use steel boxes he would adopt the same method to prevent lateral wear.

Mr. R. H. Briggs, Kansas City, Memphis & Birmingham, testified to the efficiency of babbitt as a means of taking up the lateral wear of engine truck boxes.

Mr. L. C. Noble, Houston & Texas Central, said that babbitt did well in a box, but it caused rapid wear of the journal.

Mr. A. Dolbeer, Buffalo, Rochester & Pittsburgh, had been prejudiced in favor of the half-round brass, and intended immortalizing himself by using nothing else, but found that engines came in with gibs and went out again without any repairs to boxes. This converted him into favoring the use of gibs.

Mr. Montgomery, Central of New Jersey, found that the use of brass gibs was cheaper than using hexagon brasses.

Next report read was that on

BEST BOILER COVERING.

Your committee, intrusted with the subject of report on "best boiler covering," beg leave to submit the following:

The predominating covering is of pine wood, secured to flexible wood hoops encircling the boiler; thus leaving an air space between the covering and boiler to the extent of thickness of the hoop. This space is generally agreed (by experimenters) as conducive to the best results, but that its effect is dependent upon keeping the air in the space in a quiescent state.

In considering the first cost, wood covering is the cheapest, but is comparatively short lived; and, if not k pt strictly in repair, rapidly parts with its effectiveness, and, in the end, is undoubtedly a costly covering.

Composite and sectional composite coverings are meeting with considerable favor; the former being applied in a plastic state, and in immediate contact with boiler. This method provides no air space, and is questionable as to producing the best results with covering of any kind. The annexed engraving and drawings submitted give particulars and manner of applying composite sectional coverings, and attention is called to that of the silicate cloth, as having the appearance of effectiveness and monumental durability.

With whatever covering used, it is always in the interest of economy to first apply to the boiler a coating of non-conducting non-corrosive material, for which plaster of paris appears to be well suited; the application being made by mixing with water and applying with a brush; and, in consequence of its rapid drying qualities, several coats can be quickly applied.

The subjoined table, taken from the *Railroad Gazette* of April 20, 1887 (Experiments on Loss of Heat by Radiation, by Mr. J. C. Hoadley, of Lawrence, Mass.), gives unmistakable evidence of the economy in covering boilers:

1	2	3	4	5	6	7
Pressures by steam gauge, pounds per square inch.	Computed time in minutes of increase in pressure.	Observed time in minutes of increase in pressure.	Loss of pressure by radiation from naked boiler in minutes.	Percentage of loss with naked boiler.	Loss of pressure by radiation from clothed boiler, minutes.	Percentage of losses with clothed boiler.
0 to 10	5.0	7.5	....	....	....	....
10 to 20	3.5	4.3	....	....	....	....
20 to 30	2.8	3.3	....	....	....	....
30 to 40	2.3	2.5	....	....	....	....
40 to 50	2.0	2.1	....	....	....	....
50 to 60	1.8	1.9	18.0	10.6	41.1	4.6
60 to 70	1.6	1.8	15.0	11.3	37.5	4.5
70 to 80	1.5	1.4	13.7	10.2	32.5	4.3
80 to 90	1.3	1.3	12.1	10.7	29.9	4.3
90 to 100	1.2	1.2	10.9	11.0	24.3	4.9
100 to 110	1.2	1.2	9.4	12.8	21.0	5.7
110 to 120	1.1	1.1	8.5	12.8	19.2	5.7
120 to 130	1.0	1.0	7.6	13.2	18.8	5.3
130 to 140	1.0	1.0	7.3	13.7	17.3	5.8
Mean.	....	....	....	11.8	....	5.0

The following extracts from the *Gazette* editorial commenting on the experiments are of value, on account of their pertinency to the subject in hand. It is stated that:

"The experiments were made with a 60 horse power portable engine and boiler, of which the following are the principal dimensions:

Cylinders	12½ × 18 in.
Inside diameter of barrel of boiler	38 in.
Thickness of plates	⅝ in.
Size of fire-box, inside	54 × 33 in.
Number of flues	63
Size of flues	2 in. diam. × 9 ft. long.
Total heating surface	402.24 sq. ft.

"The method of making the experiments is described as follows: 'After the boiler of this engine was tested with 150 pounds pressure and without being covered, steam was reduced to atmospheric pressure with water at about the nominal water line (2½ inches above the top of the crown sheet), and a good fire of dry wood was started, with the safety valve wide open. When the fire was at its hottest, with a good mass of glowing coals and partly burned wood at the bottom, the fire-box was filled with a compact firing of dry wood and the safety valve was closed.' The time required for each 10 pounds increase of pressure was then carefully noted.

"It was assumed that the heating value of the fire was sensibly constant during the period of time, 32.4 minutes, occupied in raising steam pressure from 0 to 140 pounds pre sure above the atmosphere. Although the assumption can hardly be exactly correct, it was shown that for the purposes of the experiment it was quite near enough. This was done as follows: As the weight of the water in the boiler and that of the boiler itself and its attachments, which were heated by the steam and hot water, were known, and as we know how much heat measured in thermal units is required to raise a given weight of water from a temperature of 212 degrees, the temperature of water under steam of atmospheric pressure, up to the temperature due to the pressure of 140 pounds above the atmosphere, and as the specific heat of iron is also known, we can tell how many thermal units will be required to raise a given weight of it up to the same temperature.

"The quantity of heat thus transmitted to the water and the boiler was calculated in this way, allowance being made for the modification of the specific heat of the water by temperature, and the 'augmenting weight of steam in the steam-space and its diminishing ratio of increase of heat.' When the total quantity of heat contained in the boiler and the water and the number of minutes required to transmit it are known, it is of course easy to calculate the number of units of heat imparted per minute or for any other time. With these data the time required for each increase of 10 pounds pressure was computed, and is given in the second column of the table, with the observed time in the third column, as indicated by the experiment. The results are given in the fourth column of the table, and should be read from the bottom upward.

"Mr. Hoadley remarks: 'There are some slight irregularities owing probably to the manner of conducting the experiments, but the several ratios are on the whole mutually confirmatory.

"'The boiler was afterwards clothed, first with three-quarters of an inch of asbestos cement securely held in place by a sort of "lathing" of wire cloth of ½-inch mesh, and over the asbestos a covering of hair felt, which, when slightly compressed by the outward casing of galvanized sheet iron, was also about ¾-inch thick, making the whole covering about 1.5 inches. Around the smoke-box the entire thickness was of asbestos cement. The covering was complete over fire-box casing, including the door end as well as around the barrel of the boiler, but did not extend over the steam jacket casing of the cylinder. There was also a space of six inches in height at the bottom of the fire-box, all around; it was left uncovered for convenience of access to hand holes, mud plugs and blow-off cock.

"'The process of raising steam was not again noted, as it was thought to be impracticable to make a second fire which should be known to be sufficiently like the first one to admit of useful comparison; but loss of pressure by radiation was carefully noted, the time being taken as each successive pound was reached, as well as each 2.5 pounds, the steam gauge being graduated to pounds.'

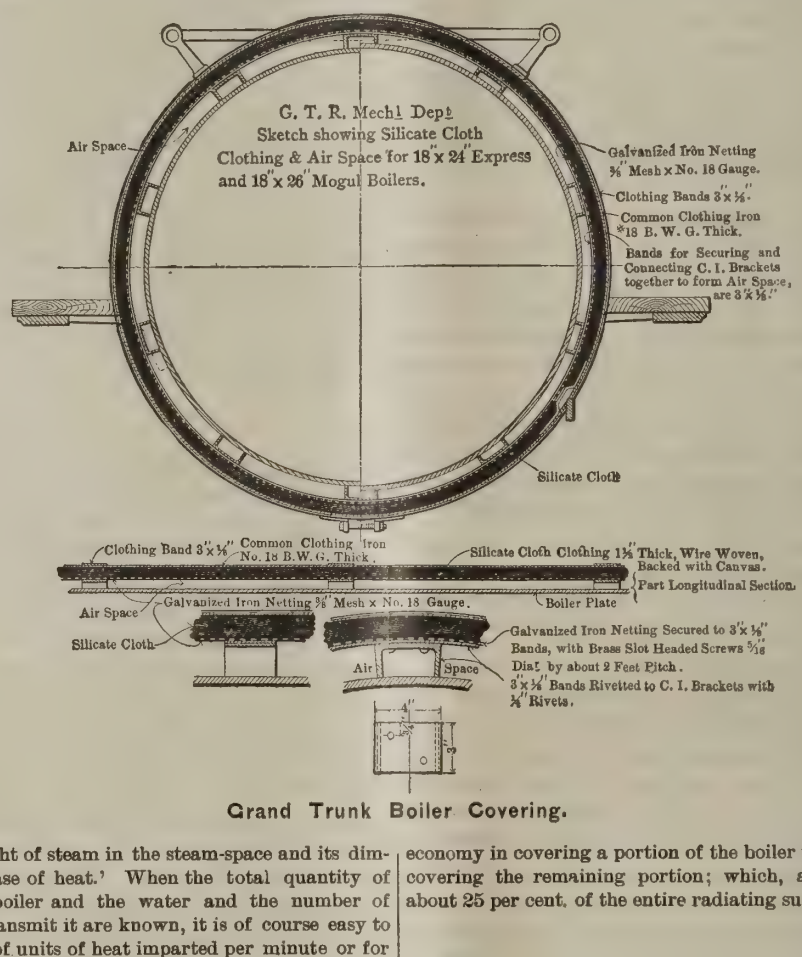
"The time as given in the sixth column of the table, and the percentage of the saving, is worked out as before and is given in the seventh column. At the bottom of the fifth and seventh columns the mean of the percentages is given, from which it will be seen that the loss by radiation from a naked boiler is 11.8 per cent. And from a clothed boiler it is only 5 per cent., or less than half of the former.

"It must be kept in mind that the experiments were made on an engine which, while they were made, was stationary, and was protected from the weather by the building in which it was placed. The conditions were, therefore, much more favorable than they are on a locomotive engine, which, while at work, is always exposed to the wind, rain and cold air, and its motion produces currents by which whatever heat can escape is rapidly carried off. As a rule it is true that locomotive boilers and engines are better clothed than ordinary stationary and portable engines, but a very large portion of the boiler is very often left unclothed. It is seldom that the fire-box shell or casting is more than half covered. All the attachments to it are so many means of communicating heat from the boiler to the surrounding air, and the lagging itself is not by any means the best non-conductor of heat. The outside of the lagging of the cylinder part of a locomotive boiler is always so hot, with steam on, as to burn a person's hand if laid upon it. The cold air sweeping over this must carry away a great deal of heat, and notwithstanding the fact that the fire-box shell is partly covered by the cab, the loss of heat from this portion must be very much greater than that from a portable engine like that with which Mr. Hoadley made his experiments."

To your committee, an ideal covering is one that admits of ready application and removal; reduces radiation to a minimum; has durable qualities; is not injurious to metal plates, and is of sufficient stability for retention of symmetrical form of outside covering or jacket, for which Russia or Planished iron has been generally adopted, and, for the purpose, is unexcelled; being durable, readily manipulated, and having a surface that pleases the eye, and strictly in accordance with the teaching of philosophy that good reflectors of heat are poor radiators: thereby beauty and utility are combined and emphasize the wisdom in selecting such material for the purpose required.

Your committee concludes that it is inexpedient, at this time, to recommend a definite method and material for boiler covering, but recognize that there is a growing tendency for a more durable and effective material than wood, and urge that the economy in covering a portion of the boiler will be augmented by covering the remaining portion; which, as a rule, amounts to about 25 per cent. of the entire radiating surface.

G. W. STEVENS,
JOHN MACKENZIE,
J. B. TWOMBLY.



Grand Trunk Boiler Covering.

Several speakers participated in a discussion that followed the reading of this paper, but the only point brought out was that it was desirable that boiler lagging should be made of good non-conducting material, or of a material that would leave a tight air space between the lagging and the shell of the boiler.

Next report read was that on

REPORT OF COMMITTEE ON DRIVER-BRAKES.

Your committee on driver-brakes find that the use of this device has within the past two or three years increased in a very marked degree, evidently accompanying the recent increment in weight and speed of both passenger and freight trains.

The still more general use of the driver-brake appears probable and will, doubtless, result in the safer operating of our railroads.

The Westinghouse Company report that up to the present time they have furnished about 7,500 sets of driver-brakes of their type, and that the American Brake Company has supplied about 3,800 sets of their style of brake. The Eames Vacuum Brake Company state that their driver-brake is in use on 364 different railways, but do not give the number of sets.

Reference to the accompanying table, "Appendix A," shows that compressed air, steam and vacuum are all undergoing extended trial as motive power for the operation of the brakes. Each has its votaries, who, under the various conditions of traffic, speed, grades and climate, uphold its relative advantages.

Some master mechanics consider it better, in view of possible failure of the power operating the train brake, and which, on account of its most general adoption, may be considered compressed air, to use either steam or vacuum for applying the driver-brake. This should be arranged without an additional handle for engineer, for as your committee are of opinion that the driver-brake should, as a rule, be used in conjunction with train-brake, on both passenger and freight engines, the additional handle would cause confusion.

The following statement received from the C., B. & Q. Railroad and showing the marked improvement made in the arresting power of driver-brakes on that railroad, illustrates what can be done by intelligent investigation, and improvements in details thereby indicated. The results of the Westinghouse brake in 1886 were obtained with the "spread" style of brake, while those in 1887 were with the "clasp" brake, which style your committee recommend in all cases where its application is possible.

Best stops with driver brakes at Burlington, brake-tests, 1886, 1887. 8 wheeled passenger engines, 54,000 lbs. on drivers, weight

of engine, tender and way-car, 168,000 lbs., 63 per cent. of this braked :

	1886. Stops in feet on level.		1887.	
	20 m. p. h.	40 m. p. h.	20 m. p. h.	40 m. p. h.
American (steam). ..	203	833	...	...
Westinghouse.....	352	1457	194	914
Eames.....	272	1002	279	1058
Carpenter.....	...	....	167	692

showing improvement in the case of the Westinghouse brake between 1886 and 1887 of 45 per cent.

Consolidation engine, with pull-brake, and shoes on all drivers, on level :

	1887. Stops in feet.	
	20 m. p. h.	40 m. p. h.
American (steam).....	330	763
C. B. & Q. (air).....	254	904

When driver-brakes are used for making all stops, each wheel should be braked, or unequal wear of tires and consequent difference in diameter will result, especially where the ordinary narrow shoe is employed; hence your committee advise the application of brakes to each driving wheel.

Experiments are now being extensively tried in order to determine the best material, or combination of materials, and also the best form, for driver-brake-shoes.

Your committee unhesitatingly recommend the principle of the Ross shoe, but are not prepared to state conclusively, until more exhaustive trials have been made, if the cast steel, the Meehan, the Lappin or the Congdon make of the Ross shoe will, all things considered, give the best results. The steel shoe, while possessing great endurance, is charged with excessive wear of the tires; but this feature may be overcome by modification in the composition and treatment of the metal.

The excellent tire-dressing results obtained by the "Ross Meehan" shoes, and as shown on blue-prints accompanying this paper, are worthy of attention.

Your committee regret that they have been unable to obtain information which would enable them to illustrate the comparative wear, under similar conditions, of the various makes of brake-shoes above referred to, and of the tires to which they were applied.

In some cases the Ross steel and the Ross-Meehan shoes are reported as out-wearing eight to ten ordinary cast-iron shoes of similar pattern; and in other cases as increasing the mileage of tires, between the turnings, from 200 to 500 per cent., as compared with the old style of shoe, bearing on the tread of wheel only.

These advantages are obvious, and when more generally understood will tend to break down prejudice against the use of driver brakes, and consequently to increase the proportion of engines so equipped.

Your committee feels compelled to point out the unfortunate existence of an excessive number of different patterns of brake heads and shoes now in general use. Where clearance between wheels is limited, specials forms of heads and shoes are necessary, but these special patterns, as well as those used where plenty of room exists, should be reduced to a minimum, and care taken to make those of a kind thoroughly interchangeable, which, it is to be regretted, is not always done.

Improvements in the proper equalization of the brakes are coming to the front, and appreciated by those fortunate enough to secure them. Some are illustrated by blue-prints herewith.

As regards the most desirable ratio between brake-shoe pressure, and weight on rail, your committee recommend for the Ross pattern of shoe, and clasp-brake, from 30 to 35 per cent.

The pressure per square inch sustained by brake-shoes varies in different designs that have come to the notice of your committee, from 50 to nearly 200 pounds. Until more is known on this point, they refrain from recommending limits within which best results may be expected.

The Le Chatelier, or water-brake, is practically a driver brake, and as a device for holding engines on heavy grades, appears to be too little known.

Mr. N. W. Sample, Superintendent M. P., of the D. & R. G. R. R. reports as regards this brake:

"We never pretended to use it for the purpose of retarding trains, as we have had all our cars and engine-tenders equipped with air brakes since 1877. For the purpose of holding light engines on heavy grades, where the tank brake is not sufficient, there is certainly nothing so good as Le Chatelier's device. We use it on our locomotives daily on grades from 100 to 408 feet per mile. We have no driver brake shoes. We discarded all brakes that apply directly to the face of the driving wheels, eight years ago. In my opinion, the very best driving brake is Le Chatelier's device."

The following communication was received from Messrs. Rhodes and Forsythe of the C., B. & Q. R. R.

"There is a great difference in the efficiency of driver-brakes, not only between different systems, but on different engines with the same system, depending largely upon the manner in which the brakes are fitted up.

"The Master Mechanics' Association could establish a standard of excellence, expressed in the number of feet on a level in which an engine (with tank loaded to weigh an even 50,000 pounds) could stop itself at speeds of say 20, 40 and 60 miles per hour.

"Any master mechanic could easily make a list of the driver brakes of his engines, and by comparing the results with figures presented by the Association as showing a high efficiency, he could tell at once how good or how bad his driver brakes were working, and thus having a measure of their efficiency, would better appreciate the necessary improvement. We regard this as the most valuable work the Master Mechanics' Association could do on the subject of driver-brakes."

This letter came to hand at too late a date to enable your committee to take any action in the direction named, but it is to be hoped that within the next 12 months some of the members will be induced to experiment with a view of obtaining data that will be useful in establishing standards of efficiency, as suggested by Messrs. Rhodes and Forsyth.

Respectfully submitted by

CHARLES BLACKWELL,
H. D. GORDON,
W. H. THOMAS, } Committee.

Mr. T. W. Gentry, Richmond & Danville, said that they had experienced difficulty in making shoes hang true with the wheel when the system of floating levers was used.

APPENDIX "A."

STATEMENT ACCOMPANYING REPORT ON DRIVER-BRAKES.

NAME OF RAILROAD.	No. of engines equipped with driver-brakes.				No. of engines with brake operated by			No. of engines with			Remarks.
	Pass.	Frt.	Switch	Total.	Air.	St'm.	Vacuum.	Spread type.	Pull type.	Clasp type.	
C. & E. I.....	8	31	10	49	8	41	0	30	19	0	Brake to be used:
C. & O.....	38	89	4	131	95	36	0	103	28	0	For emergencies only.
C. & W. Ind.....	0	5	20	25	12	7	6	5	20	0	For all stops.
C., B. & Q.....	90	287	92	469	469	0	0	385	84	0	" "
Cent. Vermont.....	3	10	3	16	0	1	15	0	16	0	For emergencies only.
C., R. I. & P.....	105	181	75	361	1	1	359	311	50	0	" " "
C., St. P., M. & O.....	26	74	18	118	103	14	1	111	6	1	For special cases only.
Fall Brook C. Co.....	1	45	2	48	4	40	4	15	31	2	For all passenger stops and emergencies on freight.
Fitchburg.....	4	52	28	84	11	0	73	4	0	80	For all stops.
K. C., F. S. & M.....	16	87	27	130	12	100	18	84	46	0	" "
L. S. & M. S.....	90	253	123	466	90	376	0	456	10	0	" "
P., W. & B.....	124	22	33	179	179	0	0	179	0	0	" "
Wabash.....	39	80	20	139	92	47	0	136	3	0	For emergencies and special cases.
Totals.....	544	1,216	455	2,215	1,076	663	476	1,819	313	83	

Mr. Gibbs said that they had met with similar difficulty in ten-wheel engines, but effected a remedy by the use of a parallel motion.

Mr. E. M. Roberts, Ashland Coal and Iron Company, objected to the recommendation that driver brakes be used for all stops.

Mr. Mackenzie said that his engineers were all directed to use the driver brakes for all stops, and yet he found that the brake was not used sufficiently to wear down the flange and outside of the tire to keep them right with the tread. Since he began using the Ross steel shoe he had become an advocate of constant use of driver brakes, for it lengthened the wear of drivers between turnings.

Mr. R. H. Briggs believed in using the driver brakes only when it was necessary to make a sudden stop. He found that where driver brakes were used for all stops, brakemen got careless and neglected their work, so that the whole of the braking was put upon the engine.

Mr. Charles Blackwell said that there ought to be a distinction made between using driver brakes on long grades and for stops. On grades there is the liability of heating the tires and loosening them, which caused Mr. Sample to remove the driver brakes from the engines on the D. & R. Grande.

Mr. W. C. Arp, Chicago, St. Louis & Pittsburgh, mentioned that one of their 16x24 engines weighing 80,000 pounds ran 130,500 miles to first turning of tires.

Mr. P. H. Peck believed that every wheel on engine and train ought to have brake shoes applied to help in stopping quickly.

Mr. Swanston favored using the brakes for all stops and he preferred to control the power with one handle. Believed in designing the driver brake so that the shocks transmitted through the wheels should be received by the pedestal shoe and not by the wedge. Had an engine fitted with Ross steel shoes which made 168,000 miles between turnings, the wear being $\frac{1}{10}$ inch for about 20,000 miles.

Mr. McCrum found that the steel shoes greatly increased the mileage of tires between turnings.

Discussion closed and next business taken was the discussion on

AXLES FOR HEAVY TENDERS.

Mr. W. H. Lewis found that the M. C. B. axle was strong enough for loads of 50,000 or 60,000 pounds, but the journal bearing was not large enough to prevent heating. Recommended an axle with journal 4 by 8 inches, and of a length that could be used in ordinary truck and box.

Mr. S. H. Harrington, New York, Lake Erie & Western, believed in making a heavy axle the same distance between centers of journals as that of the existing M. C. B. standard.

Mr. Boon believed that 75 per cent. of the hot boxes were caused by wear at the collar, and recommended a collarless journal as a remedy.

Mr. W. H. Thomas, East Tennessee, Virginia & Georgia said: I am using a bearing with the end stop cast on it. In addition to the stop thus provided, we use a chilled cast iron stop which drops in between lugs cast on the inside of the box. When the bearing

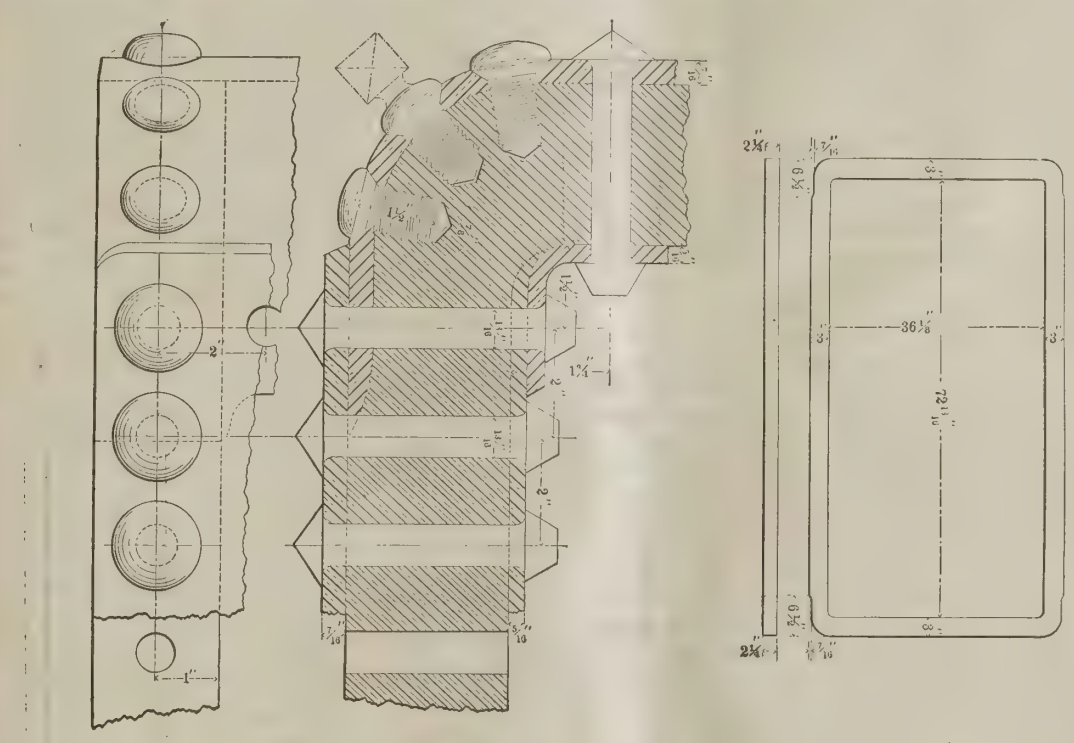


FIG. 1.

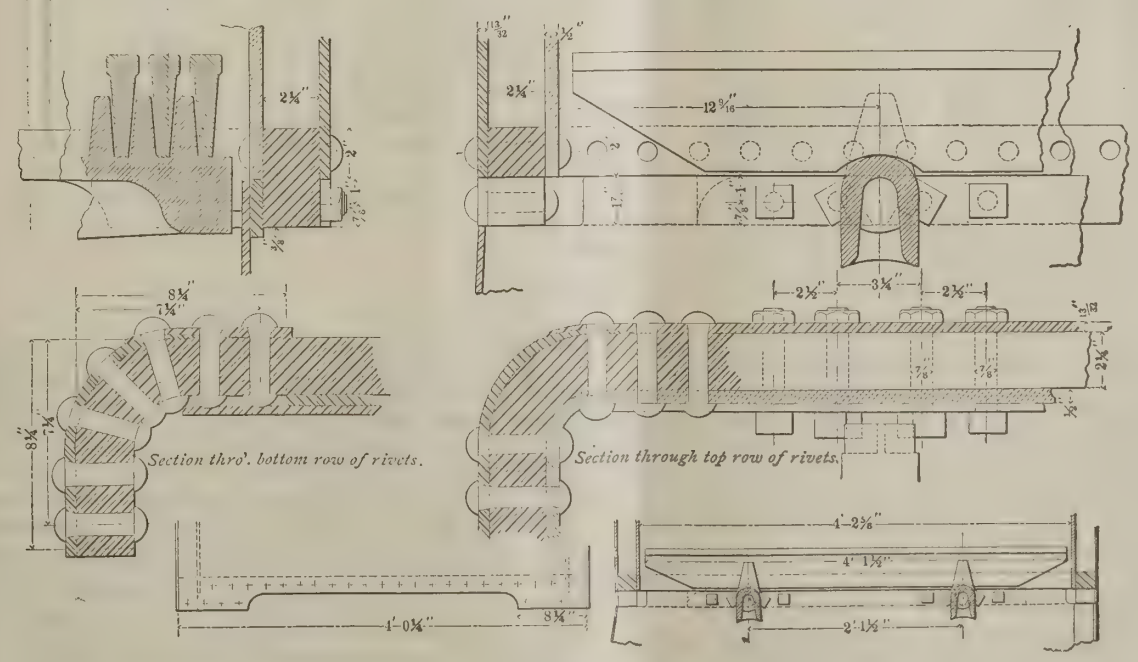


FIG. 2.

is in position it prevents the cast iron end stop from getting out of place. We use no wedge with this bearing. The journal is 4½ by 8 inches, and the back of the box clears the wheels but ¼ inch when new and soon finds a contact. We have from 1,000 to 1,200 cars thus fitted. The end of the axle outside of the wheel fit is turned straight, 4½ inches diameter.

Mr. Blackwell thought turning the axle outside the wheel would weaken it at the dust guard.

Mr. Lauder favored a journal 4¾ inches diameter.

Mr. J. Wilson: We have used the collarless axle for years on passenger cars, and have tried several designs. With the end stop a part of the brass we found the inner end of the brass wore down more rapidly than the outer, and believed it due to the leverage of the lip or end stop. We are now using the Bissell wedge, and it is very satisfactory.

Mr. T. W. Gentry: We find the brass wears more at the back, and that with the Bissel wedge the wear is just as great. I think that if it was due to leverage, it would be the same as when the stop was cast on the brass, but we have attributed it to dust getting in and to imperfect lubrication.

depth enough to take one row of ¾-inch rivets. The only merit this system possesses is its cheapness in first cost, and many unscrupulous builders bend the corners without upsetting the bar, and, in consequence, the ring at the corners is so reduced in thickness vertically that it will hardly hold water when new, and when put in service the strains of unequal expansion will very soon produce leaks. Until recently there seems to have been very little effort made to correct this evil, but we have gone on apparently with the idea that this defect was inherent in the locomotive type of boiler, and could not be remedied.

In Europe a variety of methods of construction have been tried with varying degrees of success. A plan, shown in drawing No 2, was furnished your committee by Mr. Webb, of the London & Northwestern Railway. An examination of this plan will show that the outside plate at the corners is double riveted, while the inside furnace-plate is fastened with a single row of rivets in the usual manner. Our experience and observation, based on practice in this country, would lead us to condemn this method, as the joints of the inside plates at the corners are those that give the greatest trouble from leaking; but the difference in practice may

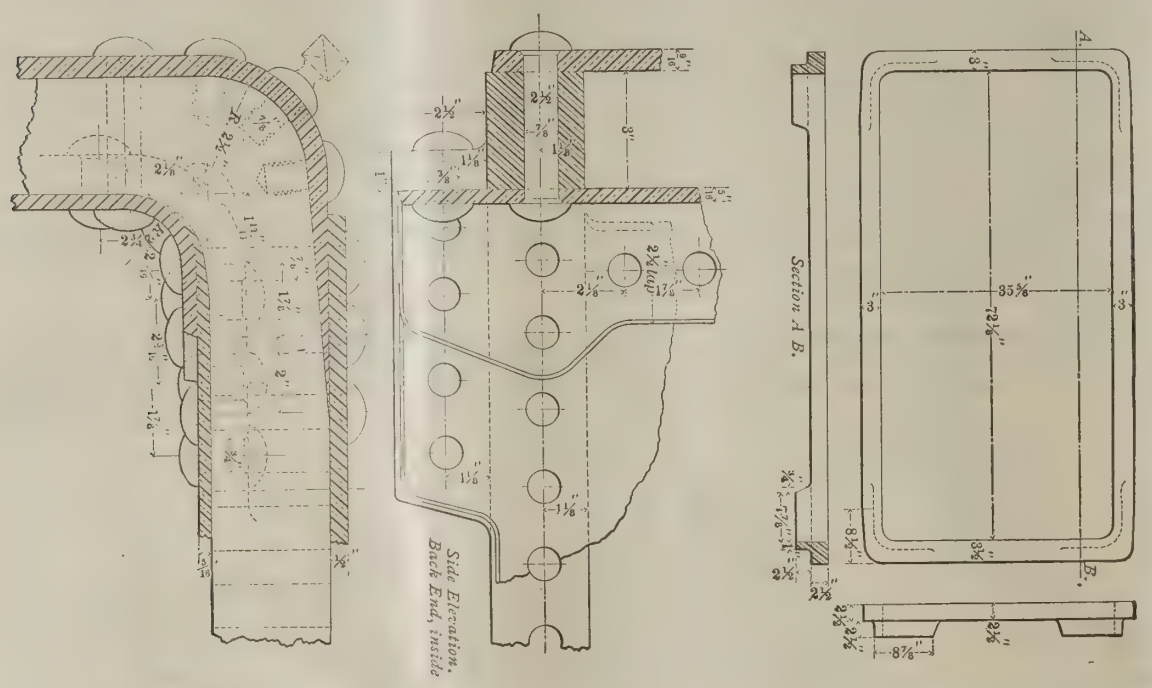


FIG. 3.

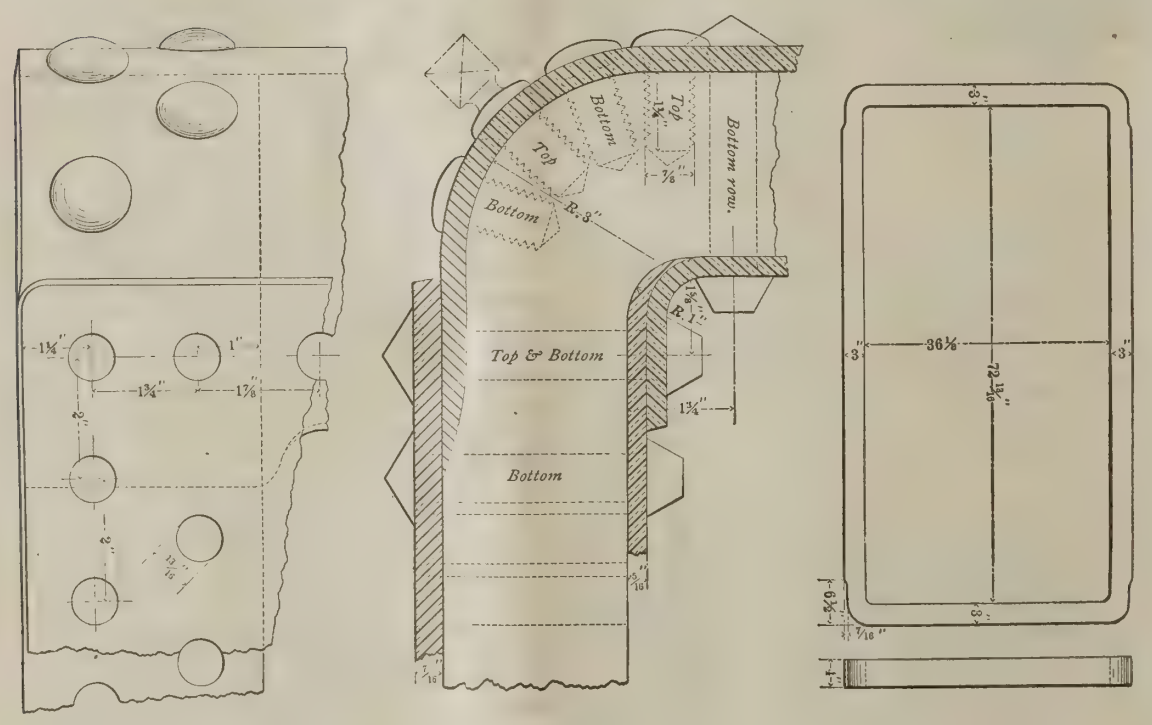


FIG. 4.

Mr. Hickey thought they might get the journal too large, since it would increase all the other dimensions in proportion.

Mr. Allen Cooke thought it better in considering the best dimensions of a new axle to leave the old light cars out of the question: None are now being built, and the old ones will soon be worn out. If we have heavier cars we need heavier trucks. If we have heavier axles and larger journals, we want some space in the box for oil and waste. Did not see the use in trying to put a big axle into a gimlet hole.

After remarks from a few more members the discussion was closed.

Next business taken up was the reading of the report on

FOUNDATION RING FOR BOILER LEG—BEST FORM AND ADVISABILITY OF DOUBLE RIVETING.

In considering the question of the best method of joining the furnace-plates with the shell plates at the bottom of the boiler leg of a locomotive boiler, the matter of first cost should be taken as a minor consideration; the obtaining of a joint that shall be durable and perfect being the all-important object, and this, when found and adopted, will, in the end, prove most economical.

The members of this Association well know how troublesome and expensive a thing is a leaky foundation ring, and how it sometimes leads to the destruction of the boiler-plates in the vicinity of such leaks, and the consequent corner patch becomes necessary. When patching commences, a new furnace is soon needed. The almost universal practice in this country has been to use a plain, rectangular bar of iron (drawing No. 1), with

be accounted for by the fact that Mr. Webb uses copper for his furnaces, while in this country steel is used. Another method, shown in drawing No. 3, is used as a standard by the Canadian Pacific Railway, and to a limited extent by several roads in the United States, notably the New York, Chicago & St. Louis, and it doubtless possesses merit as far as the corners are concerned. But the remainder of the ring is simply the plain, single riveted foundation ring, and is sure to develop leaks at other points than the corners, especially when the quality of the water used is poor.

The system of construction of locomotive boilers wherein the furnace of the boiler is placed over the frame, is rapidly coming into use, and the foundation-ring construction just mentioned would be, with this system, an annoyance. Placing the furnace over the frame increases the necessity for thorough construction of the bottom of the furnace, as leaks at that point, especially at the corners, are difficult to repair without raising the boiler from the frame, which entails a heavy expense.

Efforts are also being made to improve the ordinary method by making the ring deep enough to receive the two rows of rivets through it all round. This method, shown in drawing No. 4, your committee believe to be the best yet used, as it makes a strong and thorough mechanical job, and if the ring at the corners is properly prepared and the riveting well done, will never leak. Much depends on having the ring well prepared to receive the plates, and your committee believe that the expense of machining the ring around the corners, both outside and inside, will prove an excellent investment. Poor workmanship, with any design of foundation ring, will give trouble; and in drawing specifications great care should be taken to bind the builders very closely in the design, and the workmanship should be carefully inspected as the work of building progresses.

In conclusion, your committee would recommend a double riveted foundation ring, substantially as shown in drawing No. 4.

J. N. LAUDER,
W. J. ROBERTSON,
H. TANDY,
} Committeee.

The report was received, and a short discussion ensued, which was participated in by Messrs. Lauder, Griffiths, Arp and Mackenzie.

Then followed the reading of the report on

REPORT OF COMMITTEE ON BEST PROPORTION OF GRATE AND FLUE AREA.

The subject assigned your committee is one requiring extensive experiment if satisfactory conclusions are to be arrived at. Its members had not the leisure, much less the means, to carry out such experiments; in fact, a grant from the National Treasury would be required to cover so heavy an outlay. But it was very naturally supposed that some of our association members might have tried individual experiments by varying a normal type of boiler at some single point, and noting the effect of the variation.

With this hope your committee issued a Circular of Inquiry (see Appendix C). A summary of the few replies received is as follows:

TUBE (HEATING SURFACE) AREA.

Two have varied the tubes in boilers of similar size, viz., Mr. H. Schlacks, who added ten more tubes, improving its steaming qualities, but as the crown-sheet and tube-sheet were widened to get these tubes in, it cannot definitely be said to which of these changes the improvement is due; and Mr. G. W. Stevens, who, on a 17-inch × 24-inch × 5-foot passenger engine, changed the boiler from 147 flues, 2¼ inches diameter, to 212 of 1¾ inches diameter, the length, 11 feet 6 inches, remaining unaltered. This increased the external flue surface from 995 feet to 1,116 feet, or 121 feet—equal to 12 per cent—with an increased water evaporation of practically 7½ per cent., and after two years' experience he is able to report that the smaller size flues are not any more troublesome in the matter of stopping up than the larger flues, and also that they are less disposed to leak.

Mr. F. B. Twombley has in hand an experiment which, it is hoped, will be so far advanced in June that he will be able to give a personal report.

GRATE SURFACE.

Our queries in this matter were framed with the purpose of finding out the modifying effect of altering the amount of grate surface.

Mr. H. Schlacks reports lengthening grates (and furnaces) from 60 inches to 66 inches, keeping every other point unchanged, but he cannot note any appreciable difference in their efficiencies, and thinks it is possible to give a boiler too large a grate surface.

Mr. Wm. Garstang has 58-inch boilers, with 72-inch and 78-inch lengths of grates. Those with the longest grates are the freest steamers, but the coal consumption is about the same. However, any conclusions to be drawn from this example has to be modified by the knowledge that the longer grate has the fewer flues by 9 per cent., although they are spaced wider apart by 20 per cent. The figures are: For the short grate, 244 flues spaced ⅝ inch apart, and for long fire-box, 221 spaced ¾ inch apart.

On the general question of grate surface he thinks it is possible to get too large a surface if the coal is good.

Mr. O'Stewart reports reducing Baldwin Consolidation grates and furnaces from 120 inches to 96 inches and using a 16-inch dead-plate in front, so that the effective grate is but 80 inches long. This experiment was so satisfactory that the whole class now have their grates reduced to these figures.

On the general question of grate-surface, four others say it is not possible to give too large a surface (under the limiting conditions).

No one has experimented in the direction of reducing medium or short grates, with the hope of making combustion more rapid and thus attaining a more economical result, as, for instance, has been done in exceptional cases with some stationary and portable boilers, to their evident improvement. In exhibition contests with portable engines, reducing grate area is a favorite means of jockeying used by some wide awake competitors.

Querry No. 6 has been variously understood and interpreted. Mr. W. A. Foster under all circumstances would make the grate surface as large as possible independent of heating surface. Mr. Garstang gives 90 feet of surface to one of grate, and Mr. Schlacks from 60-65 to 1. Mr. Barnes would give a gas opening through the flues as compared with grate of 3 to 1 for 17-inch cylindered engines.

DEAD PLATES.

The question about dead plates was not generally understood, as it was commonly remarked in the replies that dead plates are put in front end of grates usually to prevent the strong blast from drawing in too much air close to flue sheet. However, Mr. Schlacks reports taking the dead plates out at back end of grate and improving the steaming, the air spaces between bars remaining unaltered; and Mr. M. Ellis removed dead plate and changed the bars, giving 56 square inches air opening per square foot of grate, instead of 47, with satisfactory results.

INTENSITY OF COMBUSTION.

No figures for comparison are given in the replies, and opinion is divided on the question of the comparative economy between slow and rapid combustion.

COAL BURNT PER SQUARE FOOT OF GRATE.

Mr. Schlacks says it is impossible to assign a limit, the best practice varying from 55 to 73 pounds per square foot of grate, and Mr. Ellis says he consumes 120 pounds, with a heating surface of 74 to 1 of grate.

EVAPORATION.

Mr. Allen Cooke gets from 7 to 9 pounds of water, Mr. Schlacks from 5½ to 6, and Mr. Ellis' best record is 8.54 from and at a temperature of 65 degrees Fahr.

In conclusion we would say that the small amount of information obtainable from the Association provoked your committee

(Continued on Page 110.)

Communications.

Tests of Axles.

Editor National Car and Locomotive Builder:

I notice in this month's issue of the CAR-BUILDER that you mention some tests of axles made by the United States Rolling Stock Company, at its Anniston shops.

Attached table, giving results of some tests made by me while inspector for the New York, Lake Erie & Western Railroad, may be of interest.

The axles were made of 6 by 1 inch merchant bar iron, at the company's Susquehanna forge, and were used almost exclusively for passenger equipment and engine and tender trucks.

In addition to the greater cost of the iron over muck bar, the process used (that of slabbing the iron and making the billet from slabs) made the axles more costly than those of muck bar from outside makers. But the result was an axle that could be depended upon for strength and having a good journal.

Number of axles.	Number of blows sustained at—					Broken at—
	10′	15′	20′	25′	30′	
3	3	2	.....	.....	.....	3d, 15′
1	3	3	.....	.....	.....	1st, 20′
9	3	3	1	.....	.....	2d, 20′
3	3	3	2	.....	.....	3d, 20′
5	3	3	3	.....	.....	1st, 25′
8	3	3	3	1	.....	2d, 25′
7	3	3	3	2	.....	3d, 25′
9	3	3	3	3	.....	1st, 30′
10	3	3	3	3	1	2d, 30′
1	..	3	4	3	1	2d, 30′
6	3	3	3	3	2	3d, 30′
7	3	3	3	3	3	4th, 30′
5	3	3	3	3	4	5th, 30′
5	3	3	3	3	5	6th, 30′
1	3	3	3	3	6	7th, 30′
3	3	3	3	3	7	8th, 30′
1	3	3	3	3	8	9th, 30′

The table comprises 84 tests, representing 4,900 axles made in one year, from March, 1887, to March, 1888.

They were required to stand three blows of a 1,640 pound drop, falling ten feet, and two blows at fifteen feet, the axle being reversed after each blow.

Weight of ram 1,640 pounds. Supports three feet, center to center. Bottom of ram was slightly hollow, so as to strike the axle over an area of about five square inches.

Diameter of axle, which in every case was tested to destruction, was 4¼″ at center. A few of these deflected as much as 5 inches at thirty feet drop, but the greater part from 3⅞″ to 4¼″.

Of the 84 axles tested, 41, or about 48¾ per cent., showed a wholly crystalline structure after fracture, while but 2, or about 2⅜ per cent., were wholly fibrous. The remainder showed both crystalline and fibrous structure in varying proportion.

You will notice that not one failed to stand the required test, although several broke comparatively low; the cause of this latter was overheating the iron.

The company manufactured these merchant bar axles up to the time of closing its shops last fall, and the tests showed fully as well as the accompanying, but few breaking short of at least one 30-foot blow.

J. W. WATSON, Inspector.

Baltimore & Ohio Railroad Laboratories,
Mount Clare, Baltimore, Md.

Behavior of Iron in Solidifying.

Editor National Car and Locomotive Builder:

It is evident that the author of the communication in the May issue of the NATIONAL CAR AND LOCOMOTIVE BUILDER concerning the "Behavior of Iron in Solidifying, etc., etc.," is either not acquainted with the literature of the subject, or blind to the value of the work already done.

From 1874 to 1880 there was a general agreement with the opinion of Robert Mallet, who read a paper on this subject before one of the English scientific societies. This paper was widely published both abroad and in this country. Mr. Mallet endeavored to prove that no expansion took place during the solidification of molten iron, an opinion hitherto taught in most reliable text-books on physics. In 1879, Thomas Wrightson (C. E., F. G. S.), a member of the British Iron and Steel Institute, read before that body an elaborate paper "On some physical changes occurring in iron and steel at high temperatures." The discussion was postponed until the next meeting in the spring of 1880, when Mr. Wrightson presented a second paper, detailing further experiments by which he conclusively proved a distinct expansion occurring in molten iron during solidification. He also presented an instrument which he called an "oncosimeter." The discussion which followed was exhaustive, and the conclusions there stated, viz.: That molten iron expanded during solidification—are now universally accepted by scientific men, among whom may be mentioned C. R. Alder Wright (D. Sc., F. R. S.), author of "Metals and their Chief Industrial Applications," and the article on "Iron" in the last edition of the "Encyclopædia Brittanica."

Mr. Wrightson's principal experiment was made in casting a ball of gray iron 15.28-inch diameter in a suitable apparatus. In 24 minutes from the run the maximum expansion was reached, .51 lineally, or 1.53 per cent. in volume.

From the maximum volume to the cold state, which occupied over 7 hours, it decreased 1.17 per cent. lineally. These figures were greater when white iron was used.

Mr. Whitney's experiments, besides lacking scientific accuracy, have not even the merit of novelty. Similar ones were performed in 1881 by Charles Markham, who presented the result of his experiments in a paper before the Iron and Steel Institute at their meeting in that year. He (Mr. M.) was unable to detect any expansion by careful measurement of the length of the bars cast. In the discussion of this paper Mr. Wrightson stated that he had performed similar experiments with varying results, and showed that no reliable data could be so obtained, as "a change of volume did not necessarily show in the length at all."

Aside from sharp casting no practical value has been found for these experiments; indeed, the poverty of practical results is to be expected, since, as Mr. Wrightson has suggested, the effect of the pressure is shown in the direction of least resistance, at the "git" or "gate," and not the hardened periphery. The time involved, 24 minutes, together with the amount of expansion, .06-inch per foot (Mr. Whitney's experiments allow about one-sixth of this amount), make it difficult to see how it could operate in a chilled casting.

FREDK. J. BEATES,
No. 629 North Eleventh street, Philadelphia.

Contracting Chills.

Editor of the National Car and Locomotive Builder:

In the last (May) issue of your journal you refer, under the title "The Cause of Uneven Chilling," to the value of contracting chills as a preventative. As the original inventor of contracting chills permit me to add a few lines relative to the subject.

The *construction* of the solid-ring chill determines that it shall increase its circumference, and hence its diameter, under the influence of heat; the *inequality of clamping* the chill in combination with the cope and drag, determines that this increase shall be in a varying degree around the circumference, causing both uneven chilling and loss of superior roundness in the wheel. To overcome these defects I invented the chill now known as the contracting chill, composed of segmental chilling blocks united to a continuous outer ring, by a radial web of expansion bars, and cast as its predecessor, the solid ring, in a single piece. The common mode of clamping the contracting chill, with the cope and drag resting upon the inner section, I found did not allow the segmental blocks sufficient freedom of action, and therefore as the difficulty was not removed as fully as I desired, I invented a cope and drag with a method of clamping which did away with all restriction of movement to the inner section. So far as my knowledge goes you are the first outside of my patent papers (No. 365,590, June 28, 1887) to advocate this great principle in wheel casting in a contracting chill, and without which I do not think it possible to cast a perfect wheel.

Aid to contraction by clamping, important as it is, is however a secondary factor, and the first great principle, *i. e., contraction*, must be sought in the chill itself. To this end, I have found practically that expansion bars in the form of *conjoined secants* are vastly superior to radial ones, acting with greater rapidity and increased contraction. Geometrically this would be suggested as true from the well-known relation existing between the increase of the angle formed by the secant and the chord of the arc, and the increase of its corresponding tangent.

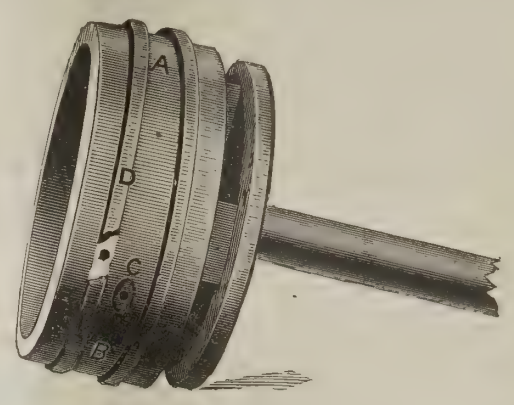
L. R. FAUGHT.

PHILADELPHIA, Pa., May 25, 1889.

During the strike on the Chicago, Burlington & Quincy system, and on various other occasions, the locomotive firemen have displayed devoted loyalty in supporting what they supposed to be the interests of locomotive engineers. This was not always what might have been expected, for the locomotive engineers' brotherhood have on various occasions not treated the firemen's organization with common courtesy. There are some indications that the results of the "Q." strike may lead to a serious quarrel between the two brotherhoods. The engineers on several western railroads are doing all in their power to get the old C., B. & Q. engineers hired whenever a new man is needed, and to increase the openings for these men they systematically oppose the promotion of firemen. On the Northern Pacific and other roads there is a rule that firemen will be promoted only on the recommendation of the engineer he has been firing for and that of the master mechanic of his division. The engineers have entered into some sort of agreement not to recommend more firemen for promotion at present, and in some instances where men were urgently needed the mechanical officers have promoted firemen without the recommendation of the engineers. The firemen as an organization are now agitating the taking a hand in the matter. They do not consider it just that the promotion of firemen should be suspended till all the "Q." men have been given employment.

A Balanced Piston.

The design of piston illustrated in the annexed engraving was invented by Mr. W. J. Thomas, master mechanic of the North Pacific Coast Railroad, the aim of the improvements being to effectually prevent the piston head from dragging on the bottom of the cylinder. It has been in use on the North Pacific Coast Railroad for two years, and is reported to save 50 per cent. of wear, and the same percentage of cylinder lubricants. No extra pieces are



used beyond those found in ordinary snap ring packing, the only difference being that the grooves for the rings are cut wider apart at the bottom than at the top, leaving a greater space on the bottom between the rings. By a suitable arrangement of steam passages steam is admitted between the piston rings, and the greater area beneath the piston causes the steam to raise the piston up and prevent it from rubbing on the cylinder. In practice it is found that the piston floats on the steam cushion. Further particulars about the invention may be obtained from Mr. W. J. Thomas, North Pacific Coast Railroad, Sausalito, Cal.

The Northern Pacific had on exhibition two new sleeping cars—one a Pullman and the other a colonist sleeper. The latter is the finest of its kind run upon any of the transcontinental roads. Its advantage over the old car is its privacy. Each berth is made as private as those in a Pullman. Separating one from the other is a solid sliding head-board. Heretofore these divisions were made with screens, and, as a consequence, gave but little privacy. Each section is fitted up with curtains, bedding, and a table. If a person does not supply his own bedding, he may purchase a complete outfit for $3. This includes curtains, blankets, mattress, pillows, sheets and pillow cases. When the journey is terminated these become the personal property of the purchaser to dispose of as he may see fit. The toilet rooms are a great improvement over the old style. They are, in fact, the equal of those found in the ordinary Pullman. One end of the car is fitted up as a kitchen, with a large range and ample water supply. In the other end is a fireproof Baker heater. The new Pullmans are even a greater novelty. They are, without doubt, the finest sleeping cars run upon any road. Each car has two state rooms—one a single and the other a double room. Each has its own private toilet room. The remainder of the car is altogether different from the ordinary sleeper. The toilet rooms are larger and much more private.—*Pioneer Press.*

A persistent attempt has lately been made to start a fight between the Union Pacific Railway Company and their enginemen. It appears that three branch lines centering at Leavenworth, Kan., have been for years operated at a loss, and the Union Pacific directors determined to put them under a separate management, with the expectation that expenses could be reduced. The management of these branches in May last made a reduction of pay for certain special runs, and the Grievance Committee of the Union Pacific proper have taken up the matter, and declare it to be a violation of the agreement made between the Union Pacific and their engineers and firemen two years ago. Engineer Vroman, chairman of the grievance committee, is known as a radical among the radicals who want to deprive railroad officers of any power in the management of enginemen, and his efforts have evidently been directed to bringing about a fight between the Union Pacific and their enginemen. The management of the Union Pacific offered to refer the matter in dispute to arbitration, but the men at first refused this, and a delegation headed by Mr. Vroman started for Boston to put the dispute before the directors. After the leaders had gone, the men most deeply interested in the quarrel got together and decided that they would be better to accept arbitration, and they wired their representatives to stop short and return. The enginemen of the Union Pacific system will make a grievous mistake if they permit any agitators to lead them into a strike. There are engineers enough idle at present west of Chicago to fill the place of every man on the Union Pacific system. Men who refuse arbitration in the settlement of a dispute put themselves in the wrong before the public at the start, and the American public are harder to fight than even the most powerful railroad corporation.

Railway Car Construction.

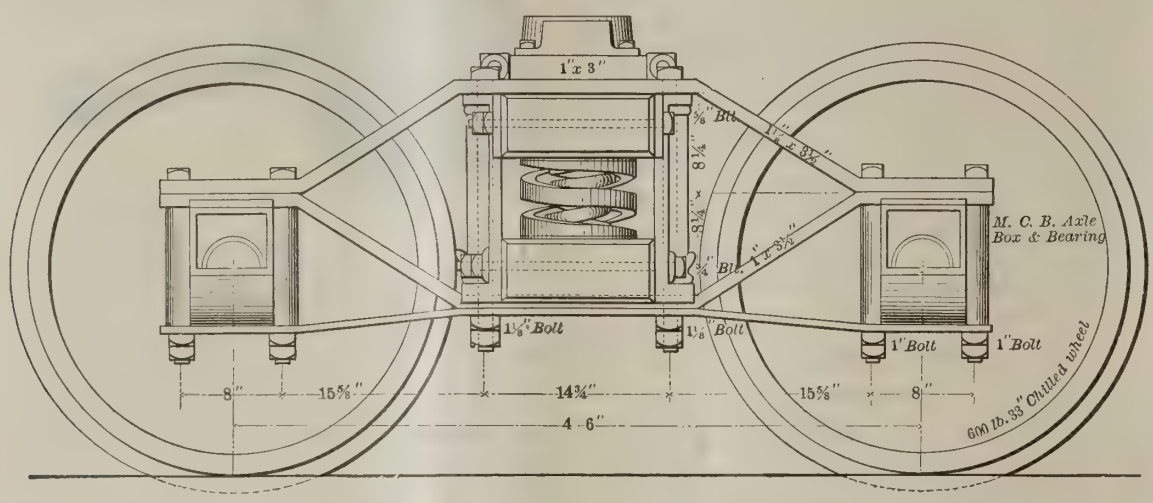
BY WILLIAM VOSS.

Tenth Paper.

TRUCK-FRAMES.

Truck-frames may be divided in two general classes, the one comprising all those having rigid centers or bolsters, and the other those having these arranged with a swing-motion so constructed that the lateral oscillations of the wheel are absorbed, and are not imparted to the car-body.

The two classes being so nearly evenly represented excludes the probability of *one* standard freight car truck however desirable such action might be; the most to be hoped for in this direction is the adoption of two, one of each type. With the swing-motion truck the side-wear on the journals and their bearings is considerably less, the wear of the whole structure perhaps somewhat reduced, and the car made to ride easier, while, on the other hand, the rigid truck-frame is cheaper to build owing to the reduction in the number of parts, and for the same reason cheaper to maintain, all the parts, such as hangers and pivots most subject to wear, being omitted. A cheaply and imperfectly constructed swing motion is also a source of much danger, a swing beam or plank precipitated on the track through the breaking of a faulty or worn hanger or pin being often the cause of a serious accident; but this last objection is now overcome, the form of hanger and the additional safety straps used make such an occurrence practically impossible.



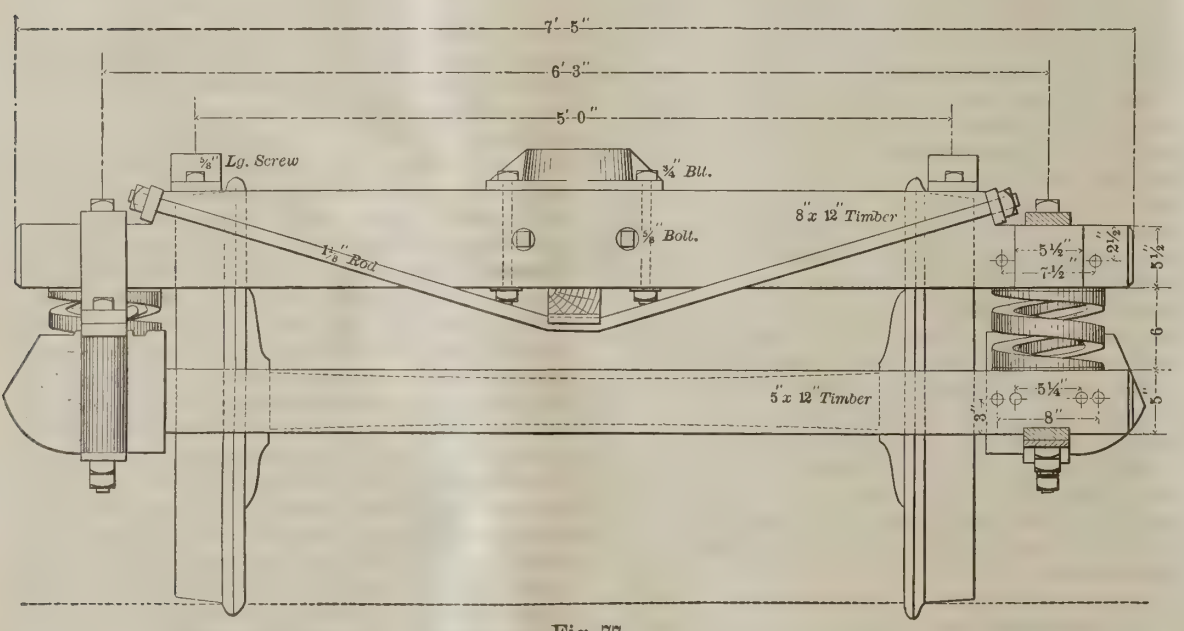


Fig. 77

Both rigid and swing trucks have substantially the same side framing, and the one mostly used is that which has from its peculiar shape caused all the trucks constructed with it to be termed diamond trucks. It is made up of flat iron bars, so shaped as to form a very powerful truss, with a comparatively small outlay for material and labor. The amount of area in the cross-section of these bars depends somewhat on the length of the wheel-base and the depth of the truss; the spread of the wheels in an ordinary rigid truck with the standard size of 33-inch wheels is about 5 feet when the brakes are applied between the wheels, but may be 6 inches less when these are hung to the car-body on the outside of the wheels. The vertical distance between the arch-bars is from 16 to 18 inches. The inverted arch-bar of the truck represented in Fig. 77, which is designed for a car of 40,000 lbs. capacity, has a cross-section of 1 × 3½ inches, while the arch-bar is 1⅛ × 3½ inches, or of ⅛ of an inch greater thickness; wrought iron of the above rectangular shape having a greater tensile than crushing strength, makes this increase necessary to prevent bending. The two bars join above the journal box on which they rest between cleats or projections cast on the box to keep them in line. A pair of 1-inch bolts pass through the bars, through holes cored in projection on the side of the box for the purpose, and through a tie-box of ½ × 3½-inch iron connecting the two boxes.

The forces developed in this truss when loaded tend to straighten the upper and more bend the lower bar; to counteract this, it has by some been thought necessary to gib the lower bar, thus relieving the journal box-bolts of all shearing strain, but commonly there is no such provision made; the fact that these bolts have never been known to shear even when loose and worn, would indicate that they are equal to this service demanded of them in addition to that of keeping the box in place.

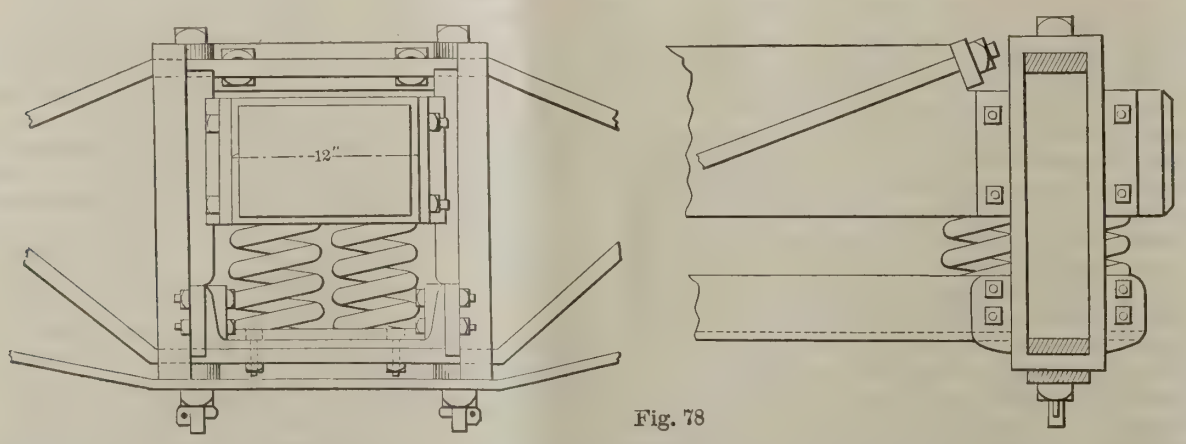


Fig. 78

For practical reasons it is necessary to locate the meeting point of the two bars about five inches to one side of the center-line of the journal, at which point the load is delivered, a condition which would bend the bars, as they have not sufficient transverse strength to prevent this, and allow the boxes to tip if this were not counteracted by the tie-bar. The holes in this, as well as those in the arch-bars, should therefore be as near the size of the bolts as practicable to prevent distortion and an unsightly appearance of the frame.

The side frames formed of the arch and tie bars, as above described, are fastened to the cross-framing of the truck by 1¼-inch vertical bolts, which must be considered a part of the truss, as they are also employed as ties connecting the lower with the upper arch bar. These bolts when used singly, as in this case, are one of the weak features of the diamond truck; the accidental breaking of one of them, a by no means rare occurrence, is almost certain to cause serious trouble, as the arch bars being without its aid, of no value for carrying the load, collapse and break. The diameter of the bolts might be increased to such a size as to make this practically impossible, if it were not that the effective strength of the arch bars would be correspondingly reduced by the larger holes, and in that manner transfer the weak point from the former to the latter. The safety strap in Fig. 78 is designed to meet this difficulty, and does it admirably although rather expensive. It is forged of flat bar iron to the shape of a square link surrounding the arch bars and the intervening column, and is shrunk in place so as to aid the bolt in carrying the load, as well as to act as a safety appliance. Projections forged on the upper and lower extremities, through which the bolt passes, furnish the means of keeping it in place.

Both column and journal-box bolts are, for want of some more reliable nut lock, either double nutted or, as in the more modern practice, have single nuts and a split-key to keep these on, as in Fig. 78. The last is in every respect satisfactory, but depends for its effectiveness on the accurate location of the slot in the bolt. The key should, when in place, bear on the under side of the nut enough to prevent any slackening, and not merely serve to keep this from loosing off.

Fig. 77 is the ordinary form of a rigid truck with wooden cross-framing. The side frames are connected by a spring plank of 5 × 12-inch oak, to which the four cast-iron columns are fastened with ¾-inch bolts as shown. The bolster of 8 × 12-inch oak, reduced at the ends to 5½ inches, so as to pass under the arch-bar, is guided in its vertical movement by the columns with which it engages through cast-iron rubbing plates or guides let into its sides, and there held by ⅝-inch bolts. These bolts, as well as those securing the columns to the spring plank, although they are usually provided with double nuts, are very troublesome to keep screwed up owing to the shrinkage of the timber and excessive vibrations, and so far nothing other than constant attention seems to be of any avail.

The bolster having in itself not sufficient strength to carry the great load placed on it, is aided by a pair of 1⅛ inch truss-rods. These pass through 1 × 3 inch wrought-iron plates placed on the shoulders formed by the reduction of the bolster at the ends, and under a cross-block and thin iron plate fastened to the under side of the bolster in the center.

Connection of the truck with the car-body is made through a pair of center-plates which are inserted between and attached to the truck and body bolsters. These plates are shaped with circular faces to permit rotation, and have suitable flanges or projections fitting into each other, to keep them in contact. They are usually made of cast-iron in a variety of patterns and dimensions, but only two of the more prominent forms are shown in Fig. 79. The first of these has flat contact faces and perpendicular flanges, while the other is circular in cross-section, having all the advantages of a ball and socket joint, but is more liable to be displaced by rough handling. Great care should be exercised in designing these plates, as the load placed on them is very heavy and the material they are made of is brittle. Stamped or pressed steel center-plates are much lighter and stronger, and although those now manufactured are very shallow and imperfect, are occasionally used.

To relieve the flanges on the center-plates of some of the strain, and to guard against an accidental displacement, a king bolt or center-pin, made of from 2 to 2½-inch round bar iron extends through the plates and bolsters. It is ordinarily inserted from above, its head resting in a cast-iron socket let in flush with the floor; but as it is in this case difficult to extract and replace when accidentally broken, or when it is desirable or necessary to remove the truck for repairs and the car is loaded, it is much better practice to apply it from below and to hold it in place by means of a key, similar to that used for draw-bar tail-bolts, which key can rest on the upper member or compression bar of the iron bolster when this is used, as is almost invariably the case in all modern cars.

The weight of the body and load is designed to be carried on the center-plates, but as these are of a comparatively small diameter, side bearings must be introduced. These are attached to the bolster at a distance of about 5 feet from each other, or the same distance as that of the wheel-treads and rails. Immediately above them and separated by an open space of ¼ of an inch, and fastened to the body bolster, are their counterparts, the *body side-bearings.* Both side-bearings are shown in Fig. 79. The lower bearing is cup-shaped, both to lighten it and to form a receptacle for holding oil and waste or some other substance to lubricate the rubbing surfaces. The upper bearing is a rectangular block of cast-iron 1¼ inches thick, of the same width and somewhat longer than the lower bearing to allow for curving. It has suitable projections

for attaching it to the bolster. Its shape is modified when used in connection with an iron body bolster, as repeatedly shown.

The intention is to have the side-bearings limit the rocking of the car-body and not that they should carry any part of the load, but in practice this is not attainable owing to the shrinkage and bending of the wood and iron used for bolsters, notwithstanding the heavy truss-rods and other precautions which produce the desired effect for a short time only. Frequent adjustment of these is therefore necessary, as too much of the load on the side-bearings prevents a ready adjustment of the truck on the curves and may cause the wheels to leave the track.

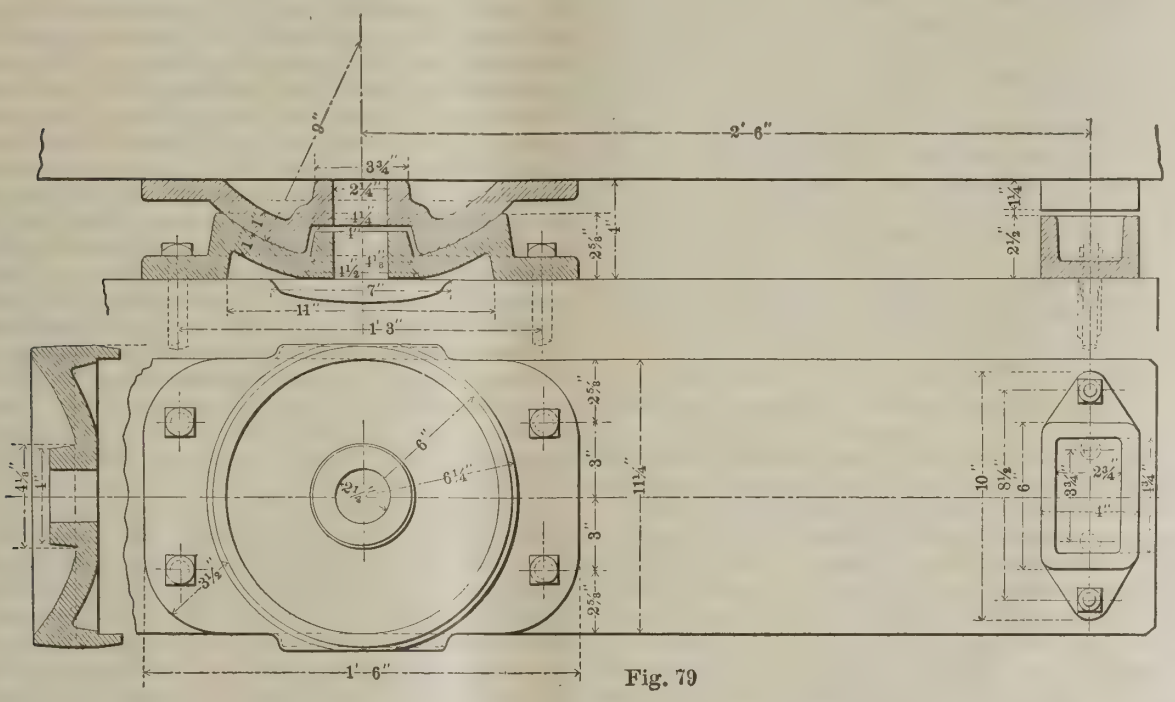


Fig. 79

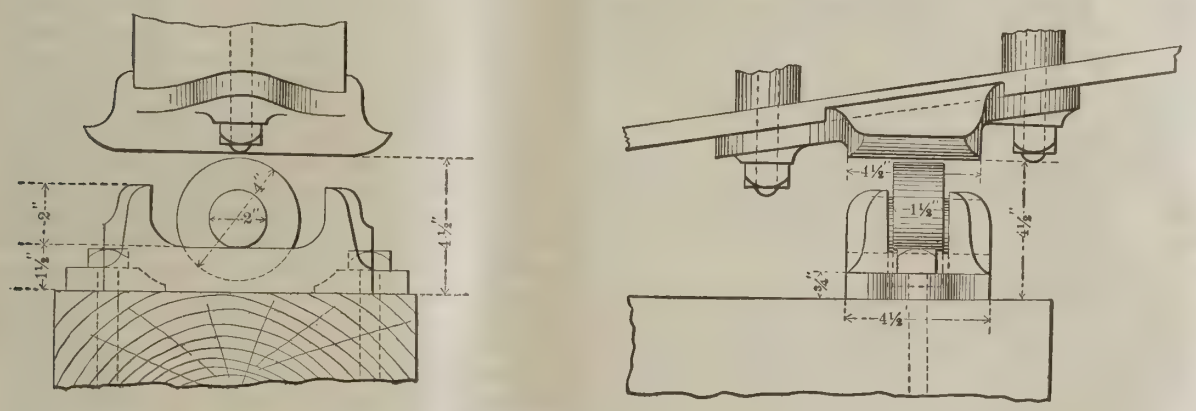


Fig. 80

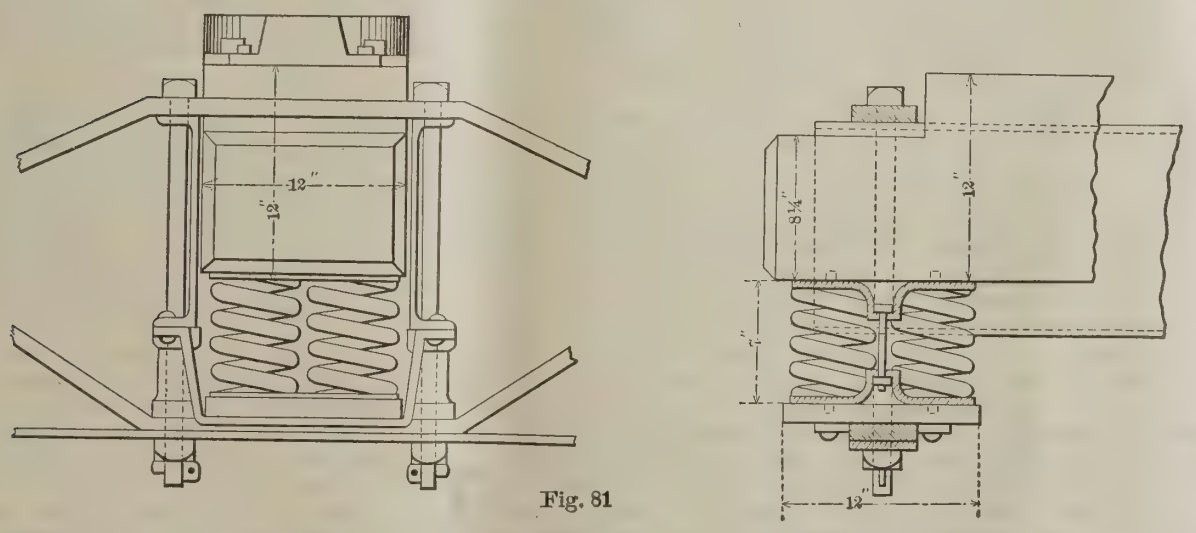


Fig. 81

A number of rolling and rocking side-bearings have been employed as a remedy. The objection to them is the same as that raised against the anti-friction or roller journal boxes: they fail to act when the rollers become worn flat or oblong, owing to their proportionately small diameter and the softness of the material used. Fig. 80 shows this bearing in its usual form. It is made entirely of cast-iron and is almost as cheap as an ordinary bearing.

The bolster rests on the carrying springs placed on the spring-plank at or near the center of the arch bars. The form of spring generally used for freight service is the spiral, the small space available for springs, and the greatly varying loads, make it impossible to construct an elliptic spring that gives any better motion. The spiral springs vary greatly in the form of cross-section of steel used, and in the number placed in a nest or group. At present the four-group single coil spring of round bar steel is the favorite, and to judge from the excellent service obtained, seems to entitle it to the preference shown it.

The coils are often in direct contact with the wood, a wooden plug or dowel being inserted to keep them from moving about; but more commonly a *spring-plate* of cast, but preferably of malleable, iron or stamped sheet metal is inserted between them and the wood. These plates are flanged on one side to receive the coils, and have projections on the side next to the wood.

The so-called iron trucks when of the rigid pattern differ from those so far described in that the wooden spring plank is replaced by an iron or steel channel bar, all other parts remaining substantially the same. This channel is made with a ⅝ or ½ inch web of the same width as the timber it is substituted for, and is placed in the truck with the flanges turned down or pointing upwards, as in Fig. 78. To the channel bar the columns are attached with short bolts or rivets extending through the flanges only; it is further fastened by two small bolts to each of the lower arch bars. These bolts at the same time serve to keep the short wooden blocks on which the springs are placed.

The bolster of this truck is of wood and with its attachments identical with that in Fig. 77.

Fig. 81 is a form of truck which, although it does not possess any exactly new features, is altogether different from any other rigid trucks. The spring plank is omitted, and the office of connecting and tieing the side-frames is performed in a superior, if slightly more expensive, manner by a pair of channel bar-transoms. The frame bolts pass through the flanges of these and through short cast-iron posts, serving as supports for the transoms and as packing blocks to close the remaining space below these. The burden spring is set on a wooden block, which rests directly on the inverted arch-bar, and is, in addition to this, supported by a pair of wrought-iron U-shaped straps riveted to the lower flanges of the transoms, as shown.

The wooden bolster, which is supposed to be of sufficient size to carry the load without the aid of truss-rods, fills the space between the channel-bars, no rubbing-plates being provided. The lateral motion of the beam is limited by the shoulders cut on its ends coming in contact with the arch-bars.

NATIONAL CAR AND LOCOMOTIVE BUILDER

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EDITORIAL ANNOUNCEMENTS.

Advertisements.—*Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING COLUMNS. *The editorial department will contain our own views and opinions; and the rest of the reading matter, aside from advertisements, will be such as we consider of interest to our readers.*

Contributions.—*Articles relating to railway rolling stock construction and management, and kindred topics, by those who are practically acquainted with these subjects, are especially desired. Also early notices of changes in railroad officers, organizations and names of companies.*

Special Notice.—*As the* CAR AND LOCOMOTIVE BUILDER *is printed and ready for mailing on the last day of the month, advertisements, correspondence, etc., intended for insertion, must be received not later than the 25th day of each month.*

The Master Mechanics' Convention.

The programme of business which was prepared for the work of the Railway Master Mechanics' Convention, held at Niagara Falls, was the longest ever undertaken in one year. It was, however, faithfully worked through, and the labor done was highly creditable to the members of the association. The reports were unusually good, and the information collected by the various committees was in every instance well digested and the grain separated from the chaff alone presented. Every one of the reports would be considered a highly creditable paper by any mechanical society. If a fault could be found with the convention, it was that some of the reports that deserved to be thoroughly discussed were passed over with little or no comment. This was a natural result of making the list of subjects too long, and we regret to find that the same mistake has been made for next year. The members sat very patiently five hours each day working along through the business, yet a considerable part of the work was done with a view to getting through in three days, therefore it was not performed satisfactorily. We doubt if ever a better paper was submitted to the Master Mechanics' Association than that presented by the committee on "best proportion of grate and flue area," yet it was received without discussion. Had it been read on the first or second day it would certainly have provoked a discussion that would have brought out valuable facts relating to this important proportion of locomotive construction. The prominence given in the list of subjects to those relating to practices which would tend to promote the economical use of fuel was decidedly pronounced, and it is to be regretted that want of time prevented the members from supplementing to a greater extent the work of the committees by the adding of facts and opinions drawn from their personal experience.

The discussion of topical subjects, which becomes the order of business at noon each day, proved, as usual, a highly interesting and valuable feature of the convention. The members have come to regard the noon hour as a good time in which to receive the views of others on any matter that may have been puzzling them during the year, and there has certainly been manifested a highly cordial disposition to discuss from every standpoint the subjects introduced. "Topical discussions" have been the means of bringing out valuable information at the meetings of other engineering societies, and that means of ventilating mechanical subjects deserves even greater attention.

Besides the devotion to the work of the sessions the Master Mechanics' Convention was notable for the friendly forbearance of the speakers towards each other. There was occasionally manifested a rather free disposition of some of the members to banter each other. Witty retort and humorous badinage have a tendency to lighten the toil and tedium of a protracted session, but they require to be judiciously exercised, for talk uttered to tease in good nature looks differently in "cold type." The business of the convention was materially facilitated by the rigid manner in which President Setchel held the members down to the rules of debate.

The meeting was, with one exception, the largest in the history of the association, so far as the attendance of members was concerned. Including the new members, 126 members were present at some session of the convention. The attendance during the sessions was exception,

ally good, for there were seldom less than sixty members present, and frequently it approached one hundred, a fact which speaks well for the interest in the work on hand. Sitting in a room five hours without intermission listening to the reading of papers on mechanical topics or hearing the views of speakers not noted for fluency or merit might be considered tiresome when repeated successively for three days; yet the greater part of the members who attended the Niagara Falls convention went through this ordeal and appeared to enjoy it. They listened to the reports of nine committees, and arranged that eleven committees should report at next convention, so the inference may safely be made that the work of the convention is generally enjoyed.

Several members took part in the discussions of the association for the first time, and their maiden efforts promised the bringing forward of the men who not only had something of interest and importance to say, but had the capability of expressing their views clearly and tersely. Several of the older members displayed a remarkable improvement over their oratorical efforts of former years, a result that may in a great measure be attributed to the training received from the railroad clubs. While improvement in this respect was very apparent, none of the members considered it imperative that their freshly acquired powers of oratory should be exercised to bore the convention. Learning to express a man's ideas fluently in a public meeting is an accomplishment not readily acquired, and when it is attained the art must be very judiciously used or the possessor is likely to make himself a burden to his associates.

Master Car Builders' Convention.

Among the subjects arranged for consideration at the Master Car-Builders' Convention, which convened at Saratoga on June 25, there was nothing to excite special interest like what was the case when air-brakes for freight cars and the type of standard coupler were to be presented for settlement, but this did not deter the members from attending the meeting. We were afraid that the action of the committee of arrangements in putting back the convention two weeks beyond the usual time of meeting would greatly reduce the attendance, but it did not appear to have this effect, for the convention was exceptionally well attended. The convention was held so late in the month that we have to postpone to the August number a full report of the proceedings.

The various reports submitted were all carefully prepared, and the discussions that followed were interesting and well sustained, although the meeting for revising the interchange rules took up so much time that there was too little left for other business. A discussion which followed the reading of the first report revealed a curious condition of confusion of opinion among the members as to the standard height of a passenger car draw-bar. The general opinion appeared to be that 35 inches is the standard, and several of the members intimated that they were working to get all their cars uniform to that height. It was discovered, however, that in the record of standard dimensions published by the M. C. B. Association, 36 inches is given as the standard height of draw-bars for passenger cars, measured from the top of rail to center of draw-head. The question of the proper height of draw-bar for passenger cars was very properly recommended for investigation during the coming year. Twenty years ago, at the third annual convention of the Master Car-Builders' Association, a resolution was adopted making three feet as the proper height of draw-bar for passenger cars; but it appeared to exert no more influence upon the practice of the members than the adoption of any routine motion and no more than the resolution passed at the same time making 32 inches the standard height of freight car draw-bar. So many important companies have adopted 35 inches as the height of draw-bar for passenger equipment that that is practicially the standard, and it is time that it was officially declared to be so. There is much more necessity to-day for the draw-bars of passenger and freight cars being of a height that will couple readily than there was twenty years ago, and the settling of the height of passenger car draw-bars at 35 inches will be a move in the direction of uniformity.

Of the other reports read, those on car heating and lighting, standard axle for 60,000-pound car, and standard brake gear for air brake cars, excited the greatest interest and led to lengthy discussions. The committee investigating the subject of standard journal-box lid for a 60,000-pound car, and a standard lid for a 40,000-pound car, reported in favor of the Fletcher lid as a standard, and it was sent to letter ballot. A prominent member of the Master Car-Builders' Association, discussing the merits and weaknesses of various oil-box lids in the April number of the NATIONAL CAR AND LOCOMOTIVE BUILDER, comments on the Fletcher lid as follows: "It is too well-known to require any description here, only to comment on its weak points. This cover is held to its position by a bolt at one end, a spiral spring being placed between the head of bolt and face of cover, to press the cover tight to face of box. The same objections, that have not been remedied, were found with this principle, as all the previous ones, *i. e.*, when the box got hot the spring lost its temper, resulting in the cover becoming so loose that, although closed, as soon as the car moved it would drop open; also, if the cover had been by carelessness, or by oversight left open, it would not close itself by motion of car or gravity. There are two serious objections to this principle which have made it quite evident that no cover with spring attachment will answer the purpose. What is required for a successful cover is one that will close itself if left open; that can be opened without the use of bolts or keys; that has no spring attachment, and will not pound itself to pieces on rough track." Those who regard these views as sound on the subject of car lids will see little merit in the Fletcher beyond the fact that the patent on it has expired. The committee on journal lubrication and best practice of economizing oils, made the use of a dust-tight air box of the utmost importance as a means of keeping journals cool and exempt from wear with the least possible attention and the smallest practicable supply of oil. Those who are earnestly trying to improve the housings of journals would do well to find out how far the reports of the committee on box-lids and on lubrication agree.

There is every prospect that the work of the convention will result in the adding of several important standards to the list adopted by the Association, among which will be an axle for a 60,000 pounds car.

Pro pects of American Compound Locomotives.

The officers of the Pennsylvania Railroad Company are not giving out any official information about the performance of the Webb compound locomotive, and there is a general impression that the engine is very nearly a failure. The engine has a weakness which is fatal to the reputation of any locomotive among American trainmen, *i. e.*, she is what is called "logy" in starting. Many of our brightest locomotive designers, who have arranged the valve motion of engines so that the best results would be obtained at high speed, have found that their intelligent efforts produced a machine which never could find favor with train men, for the simple reason that she would not lift a heavy train quickly into speed. "She is smart as a steel trap" expresses the average engineman's ideal of merit in a locomotive, and the engine which lacks the capacity to develop extraordinary starting power is liable to find a mountain of prejudice opposing her progress into favor; many inventors have learned to their sorrow that the blind opposition of ignorant engineers has vanquished many an improvement.

In spite of the many disadvantages which a locomotive must labor under which is derided and opposed by those who are supposed to understand her merits or failings, the Webb locomotive is reported to do her work with 33 per cent. less fuel than what is used by ordinary locomotives doing the same service. If this report is correct, and it came to us through a source which we have reason to believe is reliable, it would pay many roads to put up with numerous inconvenient peculiarities which the engine is reputed to labor under. As a smoke consumer she is said to be as nearly perfect as could be desired.

Meanwhile the presence of the Webb compound in this country has directed the attention of railroad men to that principle in locomotive construction in a manner that compels consideration. The engine itself is an object lesson worth years of advocacy by inventors and engineering journals. There is now a decided disposition being manifested by railroad master mechanics and others to inquire into the merits of the compound locomotive, as was indicated by the Railway Master Mechanics' Association, putting it first on the list of subjects for investigation during the current year. We shall be very much mistaken if several more compound locomotives are not at work on American railroads within the next year. Several master mechanics are quietly finding out at what expense they could convert an old locomotive into a compound, and into the practicability of using live steam in the low-pressure cylinder in starting or during hard pulls. We also understand that the Canadian Pacific Railway Company are in communication with Mr. Worsdell about introducing a modification of his patents on one or more new engines soon to be built for the company.

The propriety of building compound locomotives for trial has been talked of by some of our most enterprising locomotive builders, but we are not informed if the scheme has got beyond the range of mere talk. The most practical way to decide whether or not the compound locomotive could be made adapted to the conditions of American train service would be for a locomotive builder to construct such an engine and send it for trial to a road where coal is expensive. Where coal costs $5 a ton or upwards a railroad company could afford to put up with some inconveniences in a locomotive that would save a quarter of the fuel used by other engines. The American build of engine is admirably adapted for compounding, and the trial would not entail expense that ought to frighten any enterprising firm. The chances of success are reasonably good, and it would be a highly remunerative piece of enterprise if it succeeded. The most surprising part of the case is that our enterprising locomotive builders have shown so much reluctance about the finding out for themselves what there really is of merit in the compound locomotive.

Discussing the Rules of Interchange of Cars.

An important change was made in the rules of interchange of cars at the 1888 convention, which appears to be working very satisfactorily. Before that time the executive committee of the Master Car-Builders' Association performed the duties of settling disputes which arose in the interchange of cars. At the Alexandria Bay meeting the rule relating to this matter was changed to read: "To better settle all disputes arising under the rules, and to facilitate the revision of the same at the annual meetings, a committee of the representative members shall be appointed annually, to be known as the Arbitration and Revision Committee, who shall ask for suggestions of changes, amendments and additions to these rules, and who shall revise and formulate such replies as they may receive before presentation at the annual meeting." When this committee, exercising the authority bestowed upon the members by the Master Car-Builders' Association, sent out requests that the various railroad clubs should discuss the rules of interchange of cars and make recommendations to the Arbitration and Revision Committee of changes considered necessary, we were afraid that the plan would result in the devising of needless changes in the rules, and in an increase of useless talk at the meeting held annually to revise the rules. The first meeting worked under the new arrangement has passed, and we are agreeably disappointed. The Arbitration and Revision Committee presented on a printed form the changes which they recommended, and in most instances they were accepted by the meeting without change. This greatly facilitated the work of revising the rules. Little more than one day was devoted to discussing the rules of interchange. Had the changes recommended by the committee been examined and criticised as searchingly in every clause and sentence as the other rules were, which were supposed to need no amendment, all the time of the convention would not have sufficed for the work. The changes which were effected on the rules by recommendation of the committee were evidently made for the purpose of rendering the meaning plainer than it was before. We are by no means certain that the work was necessary, and we still believe that it would be a wise procedure to let the rules of interchange of cars alone long enough for car inspectors to get properly acquainted with them. Listening to the discussing of the interchange rules is not an edifying experience, even although it reveals curiosities in the ingenuity displayed by some of the speakers in finding excuses for displaying their oratory.

The only important change made on the rules of interchange was that which gives a company permission to turn down the wheel seats of foreign axles $\frac{1}{16}$ inch to aid in fitting on wheels. This practice has been universally followed without the permission, and is to a certain extent a mechanical necessity, for a loose wheel nearly always puts a wheel seat so much out of shape that a light cut is necessary to true it; but the privilege of turning down an axle at a point likely to weaken it needs to be exercised very judiciously.

The brake gear on many cars is hung so low that accidents are likely to happen through the attachments coming in contact with crossing planks or other connections of the permanent way. The rule that applies to this defects says that brake levers and connections must be at a safe height above the rail. A question was raised as to what is a safe height, and after a wearisome deluge of talk it was decided to insert a specific requirement as to the height above the rail, and $1\frac{1}{4}$ inches was agreed upon as the minimum. The judgment of the car inspector was exchanged for the distance named. During the interval for luncheon that followed shortly after this decision, the members got considering the probable effect of the change, and when the meeting was again called to order the rule was reconsidered and left as it originally read. We believe that the members came to a wise conclusion on this question. Few of them knew just how low it was the practice to hang their brake attachments, and still fewer could tell how high they must be to clear all parts connected with the permanent way. The matter will be much better understood by next year; but even after members have had a year in which to measure the height of their brake beams and levers, and to find out what height above the rail the projecting parts of switches and crossings are set at, it will not be much of an improvement to substitute a hard and fast rule for the judgment of inspectors who know the roads cars have to travel over.

Prospects of Adopting a New Standard Axle.

After a struggle of several years' duration to reconcile conflicting interests, the Master Car-Builders' Association have sent to letter ballot an axle for a 60,000 pounds car which has every likelihood of becoming a standard. As was clearly shown in the NATIONAL CAR AND LOCOMOTIVE BUILDER of March last, by far the greatest number of axles in use under cars of 60,000 pounds capacity have a total length of 7 feet 2 inches, and are 6 feet $4\frac{1}{4}$ inches between centers of journals. This axle could not be used in the M. C. B. oil box, and the majority of the members of the association were strenuously opposed to mak-

ing it standard on that account. The Pennsylvania, the Delaware, Lackawanna & Western, the Richmond & Danville, and other large roads were using the long axle, and if they voted against an axle proposed for standard it was certain to be defeated in letter ballot. Under these circumstances there appeared to be no way out of the dilemma except the voting for two new standards. At the Saratoga convention the members displayed a willingness to adopt two new standards, but the necessity for doing this was obviated by Mr. E. B. Wall announcing that the Pennsylvania company would not oppose the adoption of a standard different from the leading dimensions of the heavy axle used on that system. This disposition on the part of a great corporation to defer to the convenience and sentiments of others gave great satisfaction, and an axle on which all other contending opinions can readily agree was sent to letter ballot. The dimensions are not exactly what any road which we know of is now using, but they come very close to most of the heavy axles in use that are designed to suit the present truck housings. The extreme length is 7 feet ¼ inch, distance between centers 6 feet 3 inches, journal 4½x8 inches. If the last convention had done nothing but arrange for the adoption of this standard, that work alone would have entitled those present to the thanks of railroad companies.

Hold Both Conventions at the Same Time and Place.

Both the railroad mechanical conventions were highly successful in every respect, this year, although they were held at different places. There is, however, a general belief that it would have been much better for both the Master Mechanics and the Master Car Builders had the two conventions been held at the same place. We can see no reason why the two associations should not agree to meet at the same place every year and hold the sessions during the same week. A change of this kind would be calculated to materially increase the membership of both the associations; it would save a great deal of time and expense in traveling to different places, and it would tend to knit the interests of the two organizations in a closer union. Many of the officers who have charge of the motive and car departments are anxious to attend both conventions, but they cannot spare the time to remain away from home for two weeks at a season of the year when the arrangements for summer travel are being put into effect, so they must elect to go to the one convention which they take the greatest interest in. This deprives the other meeting of the attendance or membership of men who would be of value in many ways, and the men immediately interested are prevented from meeting friends whose intercourse once a year would be both pleasant and profitable. The Master Mechanics' Association once passed a resolution calling upon the Master Car Builders' Association for closer fraternity, but action in the movement was suppressed by the latter association, tabling the resolution when it was brought before them. We believe that the time has come when something ought to be done to have both associations meet at the same place and within the same week. Sessions could be held on alternate days and the rules of interchange might be revised while the master mechanics were in session. It would not be difficult to arrange the order of business in such a way that each association would find increased strength and convenience from the presence of the other.

Bursting of Steam Chests.

Mr. O. Stewart did not receive much support in the stand he took in the Master Mechanics' Convention on the question presented about the cause of the "Bursting of Steam Chests," but we are inclined to think that there was more in the theory propounded than the other speakers were willing to admit. Mr. Stewart is a close observer of the occurrences that relate to his business, and he has reason to believe that the bursting of the steam chests frequently happens when a locomotive is reversed immediately after the cylinders have been oiled, and he wanted to know if others had observed the same thing. His idea was that an explosive gas was generated from the volatile oil in the hot cylinder, and that when compressed caused an explosion. In the discussion that followed the presentation of Mr. Stewart's views the members devoted their attention principally to criticising the defects of design and material that have admittedly led to the fracture of many steam chests. No part about the locomotive has been habitually so badly designed as the steam chest, and the surprise is not that many of them have broken, but that so many of them have kept whole considering the pressure and sudden changes of temperature to which they are subjected. A square, flat cover, varying from 16 to 20 inches square, which has to resist steam of boiler pressure, is frequently made so thin and of such inferior cast-iron that it has no fair margin of safety. The sides of the chest are of a shape that puts uneven strains on the cast-iron in cooling, and this tendency is frequently aggravated by sharp, weak corners. There certainly is no mystery in the breaking of steam chests, even in ordinary service.

The fact that steam chests have frequently been made so weak that they fractured under the ordinary strains of service does not prove that extraordinary pressure is brought upon them in exceptional cases like that mentioned by Mr. Stewart. On making inquiries into this subject we have obtained particulars of several cases which appear to substantiate Mr. Stewart's views. There are on record numerous instances of steam chests or cylinders bursting when engines were reversed immediately after putting kerosene into the steam chest. The forces that would be generated by the vaporization of kerosene would probably develop in a lesser extent from ordinary oil used for lubricating cylinders. A well authenticated case happened on a division of the Pennsylvania Railroad. An engineer was in the habit of running about a pint of kerosene through his cylinders once a week for the purpose of cleaning the gummy matter off the pistons. He generally applied the kerosene while running from the station to the round-house after bringing in a train. One day, just as the fireman had finished pouring the weekly dose of kerosene into the oil cups, the necessity for making a sudden stop arose and the engineer reversed his engine, an act which was instantly followed by an explosion in one of the cylinders which shattered the casting into fragments. An investigation followed, and the facts brought to light led to the issuing of an order that kerosene should not be put into the cylinders for any purpose. If any of our readers know of other cases of this kind we would be glad to receive particulars, as we are desirous of finding out what basis there is for the theory that gas generated from lubricating oils sometimes causes the bursting of steam chests. If there is really anything in it, the danger of this kind of accident would offer a new inducement for the introduction of automatic oil cups, which give out the supply constantly and in small quantities.

The greatest calamity that ever happened on the American continent devastated the valley of the Conemaugh, in Pennsylvania, on May 31, caused by the bursting of a badly constructed dam on the South Fork, a creek on the upper part of the valley. An immense flood of water suddenly released from a great height rushed down a narrow valley, wrecking towns and villages in its course and drowning the inhabitants. The manufacturing city of Johnstown suffered most severely, a great portion of the business part of the city having been utterly washed away. The loss of life was appalling, and is now estimated to have been between 5,000 and 6,000. Railroad property suffered severely, a great portion of the Pennsylvania Railroad tracks and numerous expensive bridges having been destroyed. Locomotives were washed away by the force of the flood, and many cars floated for miles amid houses and every form of property carried away by the resistless volume of rushing water. Several passenger trains were caught in the deluge, and many of the occupants were drowned. Particulars of the disaster make up a horrible tale of suffering and death, such as has seldom been recorded. The bright side of the picture is the eagerness to furnish aid to the sufferers displayed by people in every town and city on this continent. So far as human aid and sympathy can repair the losses and alleviate the distress of the inhabitants of the Conemaugh Valley, they are finding them freely and lavishly bestowed.

The Niagara Falls Convention was notable for the quiet manner in which the members spent the time not devoted to the meetings. There was more of sitting round in groups discussing railroad and mechanical problems than we remember to have noticed at any previous convention. The different subjects before the convention appeared to be more thoroughly discussed conversationally than they were in the meetings. But the leading topic of private conversation was "compound locomotives." Nearly everybody seemed anxious to receive authentic information about the performance of the Webb compound locomotive on the Pennsylvania Railroad. The members showed themselves thoroughly awake to advantages that might be derived from using compound locomotives capable of handling American trains. Most of those who discussed this subject appeared to think that freight service offered the best field for fuel saving by means of compounding. The plain Mallet type of locomotive as modified by Worsdell and Von Borries was the favorite type, but on all hands it was admitted that important changes were necessary to make the compound capable of handling American trains.

We have received from Mr. Eugene Debs, editor of the *Locomotive Fireman's Magazine*, a bound volume containing the magazine for last year. It contains a great deal of reading that is instructive and interesting to the readers for whom the publication is intended, and there are few class publications that look better after the interests of their patrons.

Personal.

Mr. R. L. Ettenger, for several years chief draughtsman of the Chesapeake & Ohio, at Richmond, has resigned to accept an important position with the Minnesota Car Works.

Mr. S. R. Ainslie, who has been appointed general manager of the Wisconsin Central, is an Ohio man and entered railroad service as an office boy. He rose through the grades of clerk and station agent to the position of superintendent. Most of his railroad life has been spent west of the Missouri River.

Mr. Gavin Campbell, who leaves the position of general manager of the Green Bay, Winona & St. Paul, to become general superintendent of the Wisconsin Central, was formerly master mechanic of the latter road. He is a Scotchman by birth, and received his first mechanical training as a marine engineer.

Mr. George C. Watrous, superintendent of motive power and rolling stock of the Detroit, Lansing & Northern and Saginaw Valley & St. Louis roads, died at his residence in Ionia, Mich., June 6, aged 58 years. He entered railway service in 1851, and had been with the Detroit, Lansing & Northern since 1874. He was master mechanic and master car builder for eleven years, and in 1885 his title was changed to superintendent of motive power and rolling stock. He was also superintendent of motive power and machinery of the Chicago & West Michigan road.

One of the most interested and constant listeners to the proceedings in the Railway Master Mechanics' Convention, at Niagara Falls, was Mr. C. B. Conger, official mechanical engineer to the Railroad Commissioner of the State of Michigan. Mr. Conger was for many years an engineer on the Chicago & Grand Trunk Railway.

Mr. Victor Kun, of Budapest, Hungary, engineer of the state railways of Hungary, is traveling in America for the purpose of making a report to his superiors on the machinery used and the methods of operating railways in America.

Mr. J. Y. Smith, who was admitted to the Master Mechanics' Association as an associate member at the last convention, is an old ordinary member of the association, having joined at the Fifth Annual Convention as a locomotive builder. Mr. Smith is well known to mechanical and railroad men the world over for his inventions connected with vacuum brakes. He has been called to Europe on business connected with the settlement of his claims against railroad companies which have used his inventions without authority.

Mr. Robert McKeon, secretary Master Car and Locomotive Painters' Association, desires us to announce that the annual convention will be held in Chicago Sept. 11.

Our occasional correspondent, Mr. George H. Baker, traveling engineer of the Chicago, Burlington & Quincy, has in press "A Manual of Instruction for the Economical Management of Locomotives." We read the work in manuscript, and consider it an excellent treatise, and one calculated to give engineers and firemen valuable information regarding their duties.

We have received a copy of the "Official Railway List, 1889." It contains about the same features to be found in it in past years, and gives a fairly correct list of the leading railway officials for May, 1889. The confusing weakness of a publication of this kind is that the current changes make it inaccurate at the time it reaches the people, who are expected to use it for a year as a reference.

One of the most common causes of loss of life on railroads is the practice of people walking on railroad tracks. Most of railroad commissioners that annually report the death or injury of persons on railroads nearly all have expatiated upon the dangerous practice of using railroad tracks for foot travel, but that does not seem in the smallest degree to lessen the practice. Of late the courts almost invariably refuse to allow damages to trespassers who get injured while walking on railroads.

There are no geographical prejudices in the Railway Master Mechanics' Association, interest in the business of the Association being the shibboleth which recommends members for any distinction that their fellow members can bestow upon them. But there are occasionally to be noticed decided demonstrations of sectional pride. When the proposition was circulated among the members at the recent convention to hold the next meeting at Chattanooga, the Southern members were a unit in insisting that their section should be recognized to the extent of holding the convention at the place named, and many of the other members exerted themselves zealously to help the decision along in that direction, freely admitting that the South deserved a share of any privileges that could be extended. The decided preference of the members in the Niagara Falls Convention was to have the next meeting held at Chattanooga, and it is to be hoped that no fool friend among outsiders will do anything to prejudice the prospects of the meeting going there, as was done with Montreal a year ago.

Master Mechanics' Convention.

(*Continued from page* 104.)

to look elsewhere, and two of its members make personal contributions as per appendixes A and B, attached.

J. DAVIS BARNETT,
F. W. DEAN,
PHILIP WALLIS.

Appendix. A.

The early experimenters in this and allied fields of investigation were Mr. C. W. Williams, Mr. J. Graham, M. Petiet and the Engineers of the Northern of France.

M. Paul Harvey carefully analyzed this experimental data (*Annales des Génie Civil*, 1874) establishing for *flue evaporation* the following law: "The quantities of water, evaporated by consecutive lengths of tubes, decrease in geometrical progression, whilst the distances from the commencement of the series increase in arithmetical progression. From which it follows that the ratio between the quantities of water evaporated by consecutive equal lengths is a constant number, N. These ratios are expressed by the equation,

$$Q_L = Q^o\ N^L,$$

in which Q_L is the quantity of water evaporated by the $(_L+1)$ length; that evaporated by the first length being $= Q_o$.

The point at which this law begins to prevail is that at which the radiation of heat from the fuel ceases, and heat is communicated by conduction alone; and it appears from the observations cited that in locomotive boilers the evaporation diminishes by nearly one-half for each 3 feet of length. Therefore the value of N in the above formula would be 0.5.

The early experiments (1842) of Mr. E. Woods and Mr. J. Dewrance were on a short boiler without strong draught. The first length of tube (6 inches) was per foot of surface almost as effective as the fire-box; the second length (12 inches) had about a third of that value. The other three divisions (12 inches each) did little evaporative work, so that the first 6 inches did more work than the remaining 60 inches length of flue. The fuel in all experiments was superior to our common soft coal.

Mr. D. K. Clarke in 1852 published his often quoted deductions, laying much emphasis on *grate surface*, saying, 1st, that the evaporative work of a locomotive *decreased* directly as the grate area increased. 2d. That it *increased* directly as the square of the heating surface, with the same area of grate. 3d. That the necessary heating surface *increased* directly as the square root of the performance; that is to say, for example, for four times the water evaporated (with the same efficiency) only twice the heating surface is required. And 4th, the necessary heating surface increases directly as the square root of the grate, with the same efficiency; that is to say, for instance, if the grate be enlarged to four times its first area, twice the heating surface would be required for the same evaporative performance, with the same efficiency of fuel.

He in effect stated there can never be too much heating surface but there may be too little; and that, on the contrary, there may be too much grate area but cannot be too little, so long as the required rate of combustion per square foot does not exceed the limits imposed by physical conditions.

His general formula for the relation of coal consumed and water evaporated per square foot of grate area per hour is

$$w = .009r^2 + 9.7\ c.$$

Where w = the equivalent quantity of water evaporated in pounds per square foot of grate per hour from and at 212 degrees Fahrenheit.

c = the quantity of coal in pounds consumed per square foot of grate per hour, and r = the surface ratio, or the ration of the heating surface to the area of grate.

Of course, there are limits to the application of such a formula, and it would probably give incorrect results for fuel being consumed at the high rate of 120 pounds per square foot of grate.

More recently, Mr. J. A. Longridge not being satisfied with any existing formula, endeavored to base one upon the well-known laws of combustion and upon the law of transmission of heat through metallic plates. These laws may be expressed as follows: The quantity of heat transmitted through a metallic plate is proportionate to the area of the plate and to the difference of temperature of the medium on one side from that of the other. The quantity of heat developed by the combustion of one pound of fuel is accurately known, as are also the weight of the gases arising from the combustion and their specific heat. It is also generally allowed that, in order to have perfect combustion, about one-third on the air admitted must pass away undecomposed. The quantity of heat, in units, generated by the combustion of one pound of fuel can therefore be determined, and the disposal of this heat is the problem to be dealt with. Now, the heat is disposed of as follows: First, by radiation from the boiler; secondly, by transmission into the water through the surface of the fire-box; thirdly, by transmission into the water through the tube surface, and fourthly, by loss in the heated gases and unconsumed air escaping through the chimney. Therefore, given the consumption of fuel per hour, then the generation of a certain number of units of heat in the fire-box becomes known. Of this a portion which is determinable passes through the fire-box surface into the water; the remainder goes to raise the temperature of the gases and the unconsumed air which enter the tubes at a temperature that can be estimated. The quantity of heat abstracted by the tube surface can also be ascertained, and the residue gives the temperature of the escaping gases lost through the chimney.

The results of his elaborate mathematical investigations are embodied in three formulæ;

$$\text{Evaporation from fire-box in cubic feet per hour} = \frac{S\,m\,x}{N} \qquad (a)$$

$$\text{Evaporation from tubes} = \frac{h\,x}{N}\left\{1 - \frac{1}{\frac{m\,s}{\varepsilon\,h}}\right\} \qquad (b)$$

$$\text{Total from boiler} = \frac{x}{N}\left\{S\,m + h\left(1 - \frac{1}{\frac{m\,s}{\varepsilon\,h}}\right)\right\} \qquad (c)$$

in which S = surface of fire-box in sq. ft.

s = surface of tubes (exterior) in sq. ft.

N = units of heat required to evaporate one cu. ft. of water from 60° into steam at the temperature of water in boiler = 70,000 units.

x = temperature of gases in the fire-box before entering the tubes above the temperature of the water.

m = units of heat transmitted per hour through one sq. ft. of surface for each degree (F) of difference of temperature = to 11 units.

$\varepsilon = 2.718$

$$h = W\,G\,w\,\sigma, \qquad (d)$$

in which W = pounds of fuel consumed per hour per square foot of grate; G = surface of fire-grate in square feet; w = weight of gases and unconsumed air arising from the combustion of one pound of fuel; and σ = specific heat of this mixture.

His method of investigation brought him to the following general conclusions, viz.:

1st. That no fixed rule can be established as the best for the relative proportions for fire-grate, fire-box and tube surfaces.

2d. That length of tube has nothing to do with economic effect.

3d. That the diameter of the tube is also a matter of indifference.

4th. That the economy of fuel does not depend upon the rate of firing.

5th. That when the quantity of fuel burnt is moderate, say 50 or 60 pounds per square foot of grate per hour, the combustion is nearly perfect. On the other hand, with hard firing a considerable loss results from carbonic oxide passing away unconsumed.

6th. That a large increase of heating surface in proportion to coal burnt only slightly increases the economical effect. In fact, within the limits of practice in locomotive engines, the economic effect is in proportion to about the fourth root of the heating surface.

O. Busse has analyzed the "Northern of France" experiments, more especially with the object of noting the influence on evaporation of the vacuum in the smoke-box. To thoroughly understand him, it may be as well to state that the experiments were carried out on a locomotive boiler with its barrel divided into four equal compartments by bulkheads, the blast being obtained from another boiler. It had 125 flues, 1.8 inches diameter inside and 12 feet long. The fire-box had 76.5 square feet of heating surface, and each tube compartment 179 square feet, or a total of 794 square feet. With compressed coal as fuel the evaporation in pounds of water per square meter of surface was as per following table:

Vacuum in smoke-box in inches of water.	Evaporation from fire-box.	Evaporation from compartments of barrel.			
		No. 1.	No. 2.	No. 3.	No. 4.
.78.....	252.7	57.6	26.8	14.3	8.8
1.56.....	300.0	82.0	44.2	23.1	15.8
2.34.....	410.5	118.1	48.4	38.7	25.5
3.12.....	460.9	105.1	55.0	34.7	25.3
3.9	417.3	149.8	68.4	46.4	30.1

Evidently there is some error in the figures, for 2.34 inches of vacuum and 3.12 inches; allowing for this M. Busse deduces the following empirical formulæ:

(I.) For the evaporation from the fire-box per square foot of heating surface per hour,

$$F = 100\ \sqrt[3]{v} + 16\ \sqrt{v} - 36,$$

where v is the vacuum in the smoke-box in centimeters (= 0.39 inches) of water.

(II.) For the evaporation from the tubes in any particular division of their length, per square foot of internal surface per hour,

$$S = \frac{25 + 32.4\,v}{(1.3 + 0.05\,v + e)^2},$$

where e is the distance of the center of the division from the fire-box tube-plate, and v is the vacuum in centimeters, as before.

(III.) For the evaporation from the whole length l of the tubes,

$$R = \frac{25 + 32.4\,v}{(1.3 + 0.05\,v)\,(1.3 + 0.05\,v + l)}.$$

He considers the maximum efficiency may be calculated by taking a vacuum of 12 centimeters (4.72 inches), and finds this gives an evaporation of 0.16 cubic foot of water per square foot of total heating surface per hour, coinciding with the best Austrian railway practice. A very common and generally accepted figure is 0.13 cubic foot for ordinary conditions of locomotive working.

The foregoing table is of interest as showing how the blast pressure (the vacuum in smoke-box) improves the evaporation from the flues. Comparing the figures for .78 inch and 3.9 inches of vacuum, we find the latter increased the evaporation of the fire-box 65 per cent., of the first tube section 160 per cent., of the second section 163 per cent., of the third section 224 per cent., and of the last section 242 per cent. Nevertheless, the flue surface is of such little value (comparative speaking) that under the locomotive vacuum it takes 29 square feet of tube surface in last section to do the duty of one square foot of fire-box, and even under the high vacuum the proportion is almost 14 to 1.

For most of the foregoing I am indebted to the proceedings of the Institute of Civil Engineers. J. DAVIS BARNETT.

Among the other business transacted at this meeting was the election of Messrs. George Richards and John Thompson to be honorary members. John A. Hill, of the *Locomotive Engineer*, New York; Mr. J. Y. Smith, Doylestown, Pa., and L. R. Pomeroy, New York, were elected associate members.

The convention selected Chattanooga, Buffalo and Montreal as the places from which the Executive Committee should select the next place of meeting.

The officers elected to serve for the ensuing year were: President, R. H. Briggs, Kansas City, Memphis & Birmingham, Memphis, Tenn.; First Vice-President, John Mackenzie, New York, Chicago & St. Louis, Cleveland, O.; Second Vice-President, Albert Briggs, Providence & Worcester, Providence, R. I.; Treasurer, O. Stewart, Fitchburg, Charlestown, Mass.; Secretary, Angus Sinclair, NATIONAL CAR AND LOCOMOTIVE BUILDER, New York.

Ten new subjects were reported for discussion at next convention.

After passing various resolutions of thanks the convention adjourned *sine die*.

We are compelled to leave out several reports for want of room.

H. H. Mansfield, 36 Pine street, New York, has been appointed agent for that city and vicinity by the Frankford Steel Company, of Philadelphia, whose products are so well known. He also represents the Whitney Car Wheel Works, of Philadelphia.

The Williames Car Heating Company has been organized, with headquarters at Boston, Mass. The general officers of the company are: Hugh McMillan, of the Michigan Car Company, Detroit, president; R. G. Chase, Boston, treasurer and general manager; R. B. Owen, general agent.

The Westinghouse Machine Company report business as in an extremely satisfactory condition. The orders for May aggregate 82 engines, footing up to over 4,500 h. p., of which 2,200 was for compound engines. The demand for the compound engine is extraordinary. In the first six days of June their orders had already amounted to 1,000 h. p.

The Keystone wrecking frog, manufactured by the Dunham Manufacturing Company, is giving excellent satisfaction. Owing to increased facilities for its manufacture, the price has recently been materially reduced. Sales of the Dunham storm-proof car door have recently been made to the following roads: Mo. Pac.; K. C., F. S. & M.; K. C., W. & N.; L., Ark. & T.; K. C., M. & B. Ry.; Richmond & Danville; N. Y., L. E. & W.; New Brunswick; Fitchburg Ry.; Cleveland & Canton; C., B. & Q. Ry.; Am. L., S. & T. Co., and Seaboard & Roanoke. They report large sales and a growing demand for the Globe ventilator; the West Shore, Boston & Maine; Central Railway of New Jersey; Michigan Central; Missouri Pacific and the New Brunswick Railway have been among recent purchasers.

Thomas Prosser & Son, agents for the Krupp Steel Works, have sent out an illustrated circular showing the form of wheel tread adopted as standard by the Master Car-Builders' and the Master Mechanics' associations. They also intimate to all concerned that, unless otherwise directed in future, they will furnish all locomotive driving wheel tires, truck wheels, tender wheels and car wheels with tires made with flange and tread conforming to the standard. This is a move in the right direction, and will do a great deal to bring about uniformity.

Those who use type-writers can obtain from the United Rubber Company, Trenton, N. J., a very useful mat to rest the machine upon. It is formed of rubber, half an inch thick, with lugs which fit into corresponding recesses in the base of the machine. It deadens all noise due to contact with the desk; produces, for the operator, an easier and more agreeable touch; and it is a plausible claim that it materially prolongs the life of the machine. It is made in shapes and sizes to fit all varieties of type-writing machines, and is a simple and inexpensive addition to the machines in use in all railroad offices.

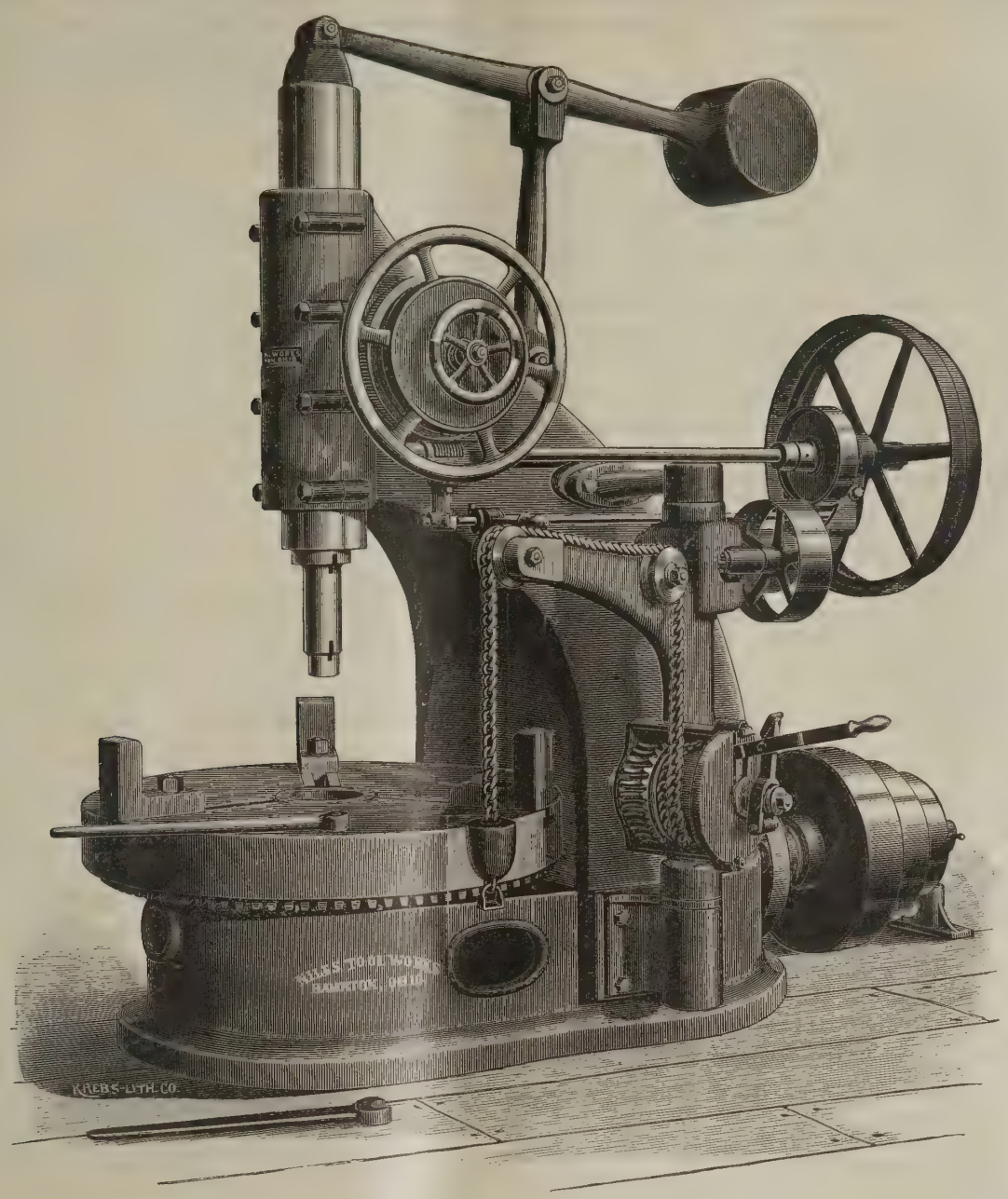
The National Locomotive Spark Arrester Company, Chicago, is putting on the market the spark arrester invented by Mr. W. Wilson, of the Chicago & Alton Railroad. It is an excellent device for preventing the throwing of sparks, and puts very little extra weight on the engine truck.

The United States Government has adopted the Magnolia metal for all the new cruisers to be built, and in several instances have removed other metals from the older vessels and replaced with Magnolia. The fine practical results attained by this metal are not alone appreciated by many of our largest manufacturers but by foreign countries as well, large quantities having been sent abroad to Germany and elsewhere. The engineers of the English navy have ordered considerable shipments made for the use of the department. In all cases these deliveries have been the outcome of severe competitive test and practical demonstration. The Magnolia Anti-Friction Metal Company, 74 Cortlandt street, New York, are proprietors of the metal.

Union Switch and Signal Pocket-Book.

The Union Switch and Signal Company, Swissvale, Pa., have issued a pocket reference book that every railroad officer ought to have in his pocket or on his desk. In the first place the handbook is handsomely bound in morocco leather and made of a size convenient for carrying. The letter type is the best of its kind, and the numerous cuts are clear and intelligible. The book describes and illustrates all details belonging to switches and signals, and many other subjects are treated which are interesting to railroad men. A striking feature about the work is the clear and thorough way in which every subject is treated, making the book a reliable manual of information. Any one who has never read a line about switches and signals can take this pocket-book and by industrious study learn practically all that needs to be known about them. A few of the divisions give information under the following heads: Description of Saxby & Farmer Interlocking, Electric Locking of Levers, Uniformity in Signals, The Illuminated Signal, Electric Locking Appliances, Sykes' System of Block Signaling, The Rail Circuit System of Signaling, Pneumatic Block Signaling, Automatic Brake Setting Attachment, Switch Stands and Targets, Crossings and Slip Switches, Westinghouse Friction Buffer. Whoever desires to obtain accurate information about any of the appliances named can learn more about them in the Union Switch and Signal Company's pocket-book than anywhere else.

The mammoth sugar refinery of Claus Speckels, of Philadelphia, is being equipped with its apparatus. The steam plant consists of thirty Babcock & Wilcox boilers, which are located on the first and second floors of the building. Each boiler is fired by a pair of Roney mechanical stokers, making sixty stokers in all. The stoker plant, together with the complete coal conveying apparatus, is put in by Westinghouse, Church, Kerr & Co., of New York, and is so arranged that the coal is handled mechanically, and without manual labor of any kind, from the time the car of coal is dumped until the ashes are shot into the ash vault. Mr. Speckels has thus far contracted for 31 Westinghouse engines as a part of the power plant. Fifteen of these engines, each of sixty horse-power, are for driving the centrifugal dryers, each engine being coupled direct to its own dryer, dispensing altogether with line shafting. The investigations on the part of Mr. Speckels, together with his architect and engineer, which led up to this arrangement, were unusually interesting and complete. An entire set of apparatus was shipped to the Westinghouse Machine Company, at Pittsburgh, together with a supply of raw sugar and the necessary workmen. The plant, including the engine, was duly erected, and the processes gone through with and the sugar refined on the spot. The power required, and cost of same, was thus carefully ascertained, and the order for engines placed accordingly.



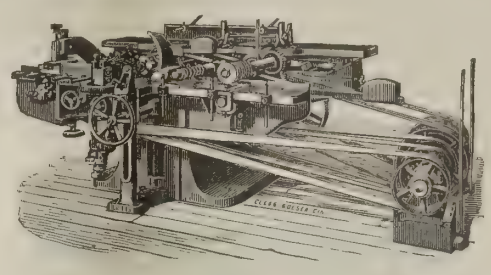
CAR-WHEEL BORING MACHINE.

The annexed engraving shows a finely designed and very powerful machine built for boring car wheels up to 42 inches diameter. The chuck is 48 inches diameter, self-centering, with independent jaws. The driving cone has three steps for a 5-inch belt, and the tool bar is counterweighted and has quick return. Provision is made for taking up any wear in the spindle, and every gear about the machine is accurately cut. The machine is provided with power crane, by which wheels may be handled with the greatest ease and very rapidly. The crane beam is low and may swing under the tool bar directly over the center of the chuck. There are three changes of feed, two for roughing and one for finishing. The change from the roughing to the finishing cut is made instantly, without changing belt or gears, and a feed of ⅝ of an inch is obtained. A striking feature about the machine is its substantial build and rigidity throughout. The column is of such a form as to partly surround the chuck with a very broad base, insuring great stiffness. The machine is built by the Niles Tool Works, Hamilton, O.

work of two separate machines, and occupies but little more space, if any, than either a separate wood worker or a separate molder.

The wood worker side consists of a 9-inch universal or variety wood worker, and has all the adjustments of an independent machine. The mandrel is made of steel and runs in our patent journal box and slide by means of which the mandrel has a lateral adjustment across the machine. This will be found very convenient in gaining, grooving, rabbetting and similar work, as it enables the operator, by a few turns of the hand wheel, to put the head to the exact place wanted, dispensing with adjusting the fence to an accurate line, which is difficult to do.

The patent outside bearing can be instantly removed to facilitate the changes of heads.



The tables are long and have a variety of adjustments which are easily accomplished. The tables raise and lower on inclines; both tables can be raised or lowered together or separately; they can be raised or lowered with the circle of the head, or vertically, and each table can be moved horizontally to or from the head. All these adjustments are made from the working end of the machine.

The patent bevel fence is made to adjust to positions suitable for all kinds of squaring up, beveling, cornering, etc. It is furnished with posts and springs to hold down the stock when necessary, and it can be placed so as to use the full width of the knife.

The molder side comprises a four-sided molder, as complete in every respect, and as available as a separate machine. Three sizes are made—eight, nine or ten inches.

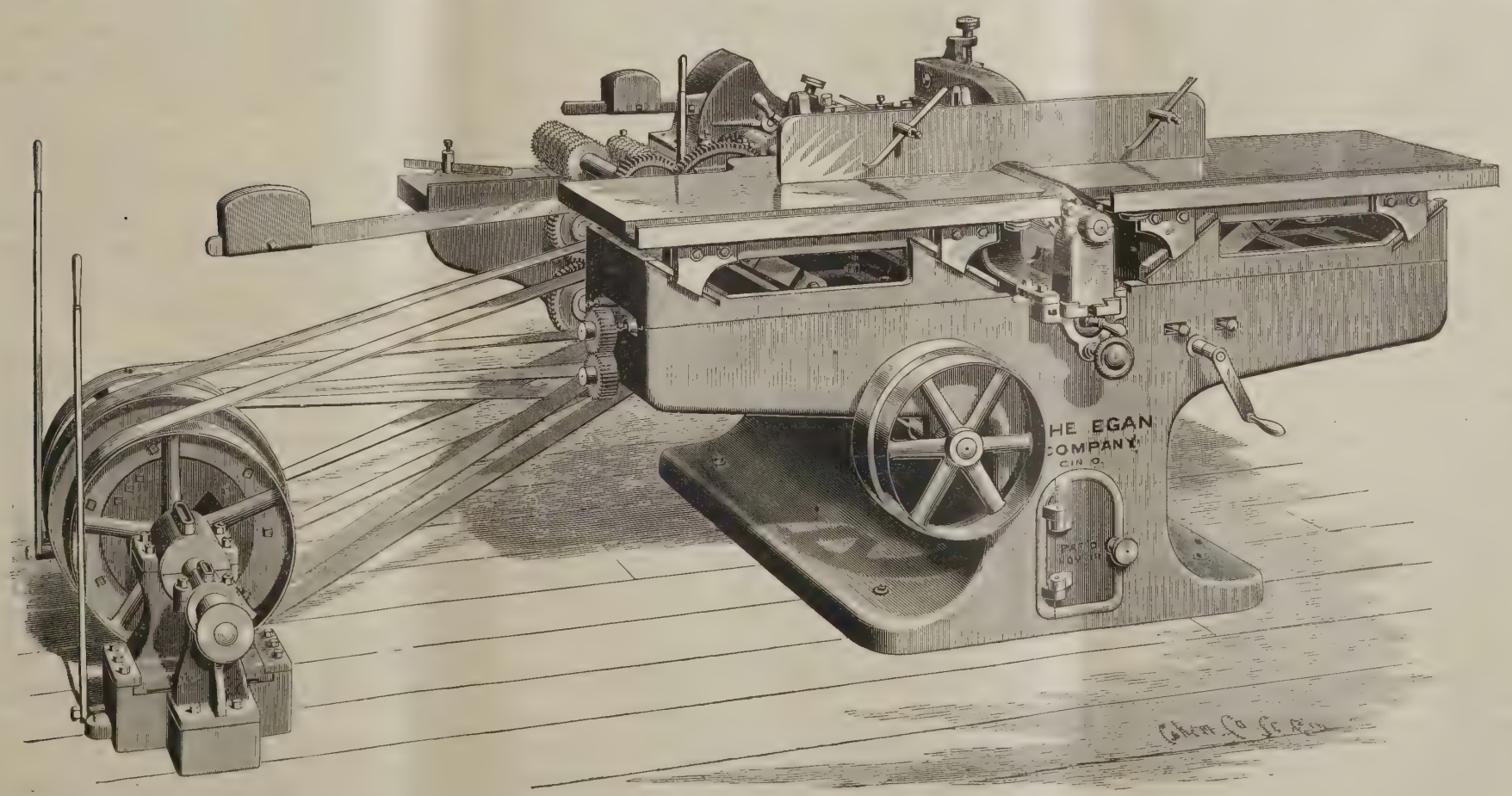
The bed is gibbed to the main column, worked in planed ways, and is adjusted by the large hand wheel in front. An improved clamping device is provided to firmly clamp the outside bearing and bed to the main column, holding them solid and rigid.

The cutter heads are steel, slotted on four sides. The two side heads and lower head raise and lower with the bed. Each side head has a lateral adjustment, and can also be beveled. All four heads have a horizontal adjustment by means of the hand wheels in front.

The feed is powerful, and consists of three geared feed rolls, two above and one in the bed; the latter is driven by expansion gearing, and the former are arranged to lift parallel; this allows the full surface of the feed rolls to rest across the board, although it may vary in thickness.

The outside bearing to the main head is bolted to the frame and reaches to the floor, and is clamped to the bed. The adjustable box can be removed instantly when a change of heads is desired.

The variety of work that can be accomplished by this combined machine, the ease with which they can be operated together or separately, and the small amount of floor space occupied in proportion to the work that can be done, makes it a valuable tool for any wood-working establishment. It will make all kinds of moldings, either straight, circular or wave; flooring, ceiling or partition stuff; will do rabbetting, gaining, panel raising, jointing,



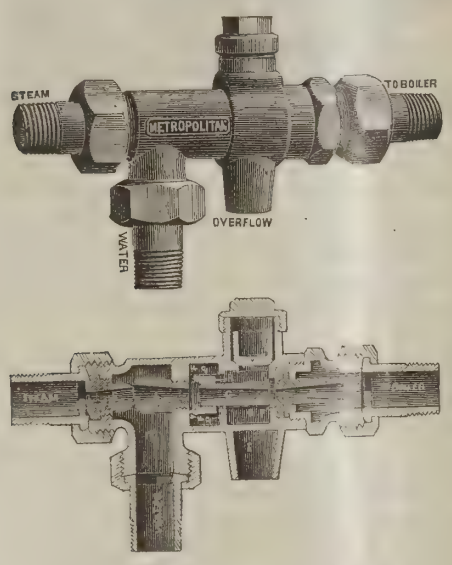
COMBINED UNIVERSAL WOOD-WORKING MACHINE.

These two machines, a 9-inch universal wood worker, and an 8-inch four-sided molder, are on one frame, cast in one piece. They are driven by a patent combined counter-shaft, which has no loose pulley, and which requires but one belt from the line shaft, thus obviating the shifting of a belt to start or stop either machine. The arrangement of the counter-shaft is such that each machine is as independent of the other as if they were entirely separate. Both machines can be run at one and the same time, or each independently at different time; all adjustments can be made; heads and bits can be put on or taken off, and they can be stopped, started and operated without the one interfering with the other in the least. It answers the purpose and does the ripping and cross-cutting, and a great variety of other work. The pulley on counter-shaft to receive belt from main shaft is 12 inches diameter and 6 inches face, and should make 1,000 revolutions per minute.

For further information address The Egan Company, Nos. 235 to 255 West Front street, Cincinnati, O.

The Metropolitan Automatic Injector.

The illustrations represent an automatic injector, possessing features which render its operation exceedingly simple, and reduce the number of its working parts to a minimum. The injector, when in working order, should always stand in a horizontal position, the water entering the bottom as shown. In our illustrations, the steam pipe is represented as connected to the injector at the left-hand side. For the purpose of regulating the steam supply, the steam pipe is provided with a globe valve (not shown) placed as near to the injector as possible. Another globe valve is placed in the suction pipe, and is used for regulating the flow of water. The delivery pipe at the right is provided with a check valve. It is a fact demonstrated by practice that if we could remove the primary overflow valve of an injector after it is started—thereby forming a communication between the primary and secondary overflows—we could work water with from ten to fifteen units of heat more than if the overflows remain closed. The fact is also demonstrated that if there is a direct



communication between the primary and secondary overflows while starting an injector, it is found not to be automatic below 70 or 80 pounds.

The improvement of this injector lies in the fact that the communication between the primary and secondary overflows is momentarily automatically closed in starting the injector; then, when once started, is automatically opened, thereby forming a communication between the two overflows.

The steam enters the injector through the jet *S*, passes into the chamber *G* through the jet *L*, causing the auxiliary check *R* to slide toward the right along the tube *C*, and thus opening a full communication between the chamber *G* and the small chamber at its left-hand side, thereby enabling the steam to open the overflow valve *V*, and pass out freely through the overflow *E*. This rush of steam draws, in the meantime, air out of the chamber *T*, creating in it a partial vacuum, which allows the water to rise from a lower level. As soon as the water reaches the chamber *T*, the steam is condensed, and a velocity imparted to the water, which passes on into the chamber *G*; as the velocity increases, the water passes through the tube *C*, and spills through the opening *F F*, forcing the auxiliary check *R* back on the tube *C*; and when this auxiliary valve reaches the partition *Q Q*, thereby momentarily closing the communication between the primary and secondary overflows, the partial vacuum in the chamber at the left of *G* allows it to regain its original position shown in the illustration, thereby opening up this communication.

As soon as the water attains a sufficient velocity to overcome the boiler pressure, the water passes on through the tube *D*, thereby forming a vacuum in chamber *G*, and causing the overflow valve *V* to close.

From this it will be seen that the construction is very simple. When an examination of the injector is necessary, it can be readily taken apart with an ordinary monkey-wrench and screw-driver.

To operate the injector it is only necessary to open fully the globe valve in the steam pipe, and also open the globe valve in the suction pipe. Should water appear at the overflow *E*, the globe valve in the suction pipe must be throttled until the discharge of water at the overflow ceases, which indicates that the water is then being forced into the boiler. After the globe valve in the suction pipe has once been set, it is not necessary to touch it again, and the injector can be stopped or started simply by opening or closing the globe valve in the steam pipe.

The injector can be started with 20 pounds of steam, and works up to 145 pounds without adjustment, and when desired can be made to work up to 200 pounds.

It is claimed that a hot suction pipe will not prevent the injector from starting readily. It is also claimed that severe jarring will not affect its working, as its automatic qualities will restart it if the feed is for any cause temporarily stopped.

Two steam jets are furnished with each injector, so as to make it either lifting or non-lifting. When used as a non-lifter, it will work from five pounds up.

This style of injector will work on any kind of boiler, but is more especially adapted for stationary, marine, portable and traction engines. Different sizes of these injectors are made, their capacities ranging from 40 to 3,480 gallons of water per hour. These capacities are based upon 65 pounds steam pressure, and 4 feet lift.

This injector was invented and perfected by John Desmond, and is manufactured for Jenkins Brothers, 71 John street, N. Y., General Agents.

That the Servis tie plate "boom" has but barely started is evident from the fact that a large number of roads have just placed trial orders, the most conservative managers are investigating its merits, and a number of the roads that have had the plate in use for some time past and subjected it to critical test are contemplating using large quantities in the immediate future.

Exhibitors at the Niagara Falls and Saratoga Conventions.

EXHIBITS.

The following is a list of the exhibits shown by the various houses represented :

The A. French Spring Co., Ltd., Pittsburgh, Pa.—The Morris steel box covers adapted to various styles of boxes ; made of rolled steel, pressed and of cast, spring steel ; also, several springs.

The Ross Valve Co., Troy, N. Y.—Ross reducing valves.

Wm. G. Robinson, 66 Broadway, New York.—The security railroad chuck.

The Detroit Lubricator Co., Detroit, Mich.—The Garfield injector, sight feed lubricator and oil cups for locomotive rods and guides.

B. E. Tilden & Co., Cleveland, O.—Car and locomotive replacing frogs.

Leland's Universal Car Heating and Coupling Co., 89 Centre street, New York.—A steam coupler and a muffler for heating water by live steam.

Hale & Kilburn, Mfg. Co., Philadelphia, Pa.—Several seats, also arrangements of springs for seats.

Anti-Friction Metal Co., North East, Pa.—Specimens of tempered copper, journal bearings, etc.

The Erie Car Heating Co., Erie, Pa., and Chicago—Joints, couplings and steam trap for car heating.

The Gold Car Heating Co., Cliff and Frankfort streets, New York.—Coupler and "Excelsior" steam trap.

The Buffalo Steam Pump Co., Buffalo, N. Y.—Photographs and blue prints of pumps and fittings.

J. M. Foster & Co., 81 Fulton street, New York.—Foster's automatic pressure regulator for steam, water, gas or air.

Schoen Manufacturing Co., 55 and 57 Laurel street, Philadelphia, Pa.—Pressed steel center plates and stake pockets.

D. E. McSherry & Co., Dayton, O.—The Maxon patent jack in various styles and sizes.

The Chalmers Spence Co., Eighth street and East River, New York City.—Samples of asbestos "fire-felt" pipe coverings and boiler lagging.

The Williame's Car Heating Co., Boston, Mass.—Steam heating coupler.

Mason Regulator Co., 10 Central street, Boston, Mass.—Reducing valve, pump pressure regulator and combined steam trap reducing valve.

H. W. Johns Manufacturing Co., 87 Maiden Lane, New York.—Various asbestos materials and indurated fibre pipe for insulation, etc.

Fairbanks & Co., New York.—Various steam specialties.

Shields & Brown Co., Chicago, and 143 Worth street, New York.—Sectional insulated air coverings.

The Union Manufacturing Co., New Britain, Conn.—The Skinner combination lathe chuck.

The Damascus Bronze Co., Limited, Pittsburgh, Pa.—Journal bearings.

E. P. Shaffer, Rochester, N. Y.—Oil cups.

C. F. Hall & Son, Skaneateles, N. Y.—Valve refitting machinery.

J. J. McCabe, 121 Liberty Street, New York.—Halsey's portable power drill.

Otley Manufacturing Co., Chicago, Ill.—Steam packing cement.

Kalamazoo Railroad Velocipede Car Co., Kalamazoo, Mich.—Standard section cars, one 6 ft. 4 in. and one 7 ft. 6 in. long, natural wood, oak.

The Northwestern Modern Car Heating and Lighting Co., St. Paul, Minn.—Steam coupling joint and trap.

The Asbestos Packing Co., 169 Congress street, Boston, Mass.—Removable coverings for steam or water pipes for car heating.

Eames Vacuum Brake Co., New York.—Blue prints and model of equalized driver brakes.

Porter & Grosvenor, Detroit, Mich.—Automatic coupling for air brake hose.

New York Car Wheel Co., Buffalo, N. Y.—A machined, cast-iron wheel, showing balance of wheel.

The Standard Car Heating and Ventilating Co., Pittsburgh, Pa.—Full size model of various parts of the return system of heating controlled by the company with trap and coupling. Also blue print of system of heating by hot air circulation.

The Jull Manufacturing Co., Brooklyn, N. Y.—Model of the Jull centrifugal snow plow.

The Buffalo Steel Foundry Co., Buffalo, N. Y.—Section of cast steel wheel.

The Martin Anti-Fire Car Heating Co., Dunkirk, N. Y.—Full size model showing method of piping, new trap, etc., with new style of coupling. In this the slip joint is done away with entirely. Great freedom of movement is secured in all directions by two ball-and-socket joints on the end of each car.

Union Switch & Signal Co. Swissvale, Pa.—The Westinghouse friction coupler, full size; also, new spring buffer.

The Scarritt Car Chair Co., St. Louis, Mo.—Forney car seats and reclining chairs.

Michigan Railway Supply Co., Detroit, Mich.—Central steel brake beam.

The Rotary Steam Snow Shovel Mfg. Co., Paterson, N. J.—Photographs of the rotary snow shovel.

Thomson Electric Welding Co., Malden, Mass.—Numerous specimens of electric welding.

The Chapman Jack Co., Cleveland, Ohio.—Hydraulic jack.

The Butler Draw Bar Attachment Co., Cleveland, O.—Butler draw-bar attachment.

The Griggs Electric Air Signal Co , Wilmington, Del.

The Hoffman Machine Co., Detroit, Mich.—Pendry's patent balanced throttle valve.

Fairbanks, Morse & Co., Chicago, Ill.—The Sheffield hand car, the Barrett track jack and other specialties.

The Westinghouse Air Brake Co.—The engineer's valve and the triple valve.

The McGuire Manufacturing Co., Chicago, Ill.—The Star grain car door blue prints.

Manning, Maxwell & Moore, New York.—A new boiler tube expander; the Richardson pop muffler safety valve for passenger engines; the Tabor steam engine indicator; also album of photographs of shops and machines and Smith's portable rail saw.

Star Machine Co., Buffalo, N. Y.—Portable bellows forge.

Ruffhead Car Door Co., Williamsport, Pa.—A flush door for freight cars.

C. C. Jerome, Rialto Building, Chicago, Ill.—A chart showing various applications of the Jerome metallic packing.

Cyclone Steam Snow Plow Co., Rookery Building, Chicago, Ill.—Photograph of the cyclone steam snow plow.

Guarantee Tool Manufacturing Co., 35 Nassau street, N. Y.—The Samson wrench.

The Non-Magnetic Watch Co., 179 Broadway, New York.—A very fine display of watches.

The Shackleton Car Heating and Ventilating Co., Bound Brook, N. J.—A system of heating shown by drawings and circular.

H. Belfield & Co., 435 N. Broad street, Philadelphia.—An improved lifting locomotive injector.

Knapp Steam Coupler Co., Spracuse, N. Y.—A universal metal coupling intended for any system of piping.

Fox Solid Pressed Steel Co., Chicago, Ill.—Specimens of pressed steel for truck frames, etc.

Wright Mfg. Co., 191 Berks street, Philadelphia, Pa.—Samples of Wright's Patent Fastening Device.

C. B. Hutchins & Sons, Detroit, Mich.—Model of car roof.

Lehndorff Car Seat Co., Detroit, Mich.—Two seats and samples of springs.

Railway Lighting and Heating Co.—Catalogue of Frost Dry Carburetter System.

Russell & Erwin Mfg. Co., New Britain, Conn.—Full size passenger car door, showing their patent door check and spring.

New York Car Wheel Co., Buffalo, N. Y.—A 40-in. "machined" cast wheel, weighing 1,000 lbs., and balanced within 6 oz.

Cordley & Hayes, 173 Duane street, New York.—Samples of indurated fibre ware.

H. A. Luttgens, Paterson, N. J.—Model of a variable exhaust damper.

Revere Rubber Co., 63 Franklin street, Boston.—Samples of air brake and steam heating hose.

Fennell Automatic Freight Car Coupler Co., Skaneateles, N. Y.—Full size link and pin coupler.

Stephen G. Scott, Plainwell, Mich.—Model of tie truss for railroad joints.

Standard Car Coupling Co., 45 Broadway, New York.—Full size draw bar of the improved Dowling coupler.

The Thurmond Car Coupling Co., 45 Broadway, New York.—Full size draw bar of the Thurmond improved coupler.

The Gould Steam Forge and Automatic Coupler Works, Buffalo, N. Y.—Two cars at the Delaware & Hudson station equipped with the Gould automatic coupler.

E. B. Arnold, Oriskany Falls, N. Y.—Model of a steel tie and model of a link and pin coupler.

The International Manufacturing Association, 10 Wall street, New York.—A model of the Morrell reversible trail deck sash.

Coburn Trolley Track Manufacturing Co., Holyoke, Mass.—Full size flush door for freight cars.

Johnston Electric Train Signal Co., Boston.—Model of electric train signal.

The Westinghouse Air Brake Co.—Iron brake beam and gear with blue points.

The Automatic Car Coupler Heating Co., Detroit, Mich.—The "Peerless" steam coupler.

Timms Car Coupler Co., Columbus, O.—Full size Timms automatic, cushioned car coupler; also the Timms patent journal box.

National Hollow Brake Beam Co., Chicago, Ill.—Full size hollow brake beam, also a beam taken from one of the Chicago & Northwestern Railway Co.'s coaches, having been in daily service two years.

Wakefield Rattan Co., Boston.—Car seats.

John Ballenden, Bloomington, Ill.—Pope's new excelsior lathe arbor and expanding mandrel.

Vulcanized Fibre Co., Wilmington, Del.—Dust guards.

Dunham Manufacturing Co., Boston.—Model of Hix car coupler.

Over Stone, Flint, Mich.—Model of the Skinner automatic car coupler.

Geo. R. Meneely & Son, Troy, N. Y.—Journal bearings.

Merrill Bros., Brooklyn, N. Y.—Drop-forged turn buckles.

The Van Dorston Cushioned Car-Coupling Equipment Co., 308 Chestnut St., Philadelphia, Pa.—Full size car coupler. Two cars at the Delaware and Hudson Canal Car Station equipped with the Van Dorston coupler.

The Robinson Car Coupler Co., Springfield, Ohio.—Full size link and pin coupler.

F. W. Bird & Son, Walpole, Mass.—Neponset rope roofing fabric.

Eureka Nut Lock Co., Marshall, Tex.—Samples of the Eureka Nut Lock.

The Elmore Car Axle Box Lid Co., Chicago.—Full size journal box lid.

Michigan Railway Supply Co., Detroit, Mich.—Central steel brake beam.

The Consolidated Car Heating Co. (successors to the Sewall & McElroy Co.s), Albany, N. Y., New York, Chicago and Portland, Me.—Couplers and blue prints for steam heating.

Westbrook & Cook, Port Jervis, N. Y.—Vertical plane M. C. B. coupler.

Gould-Tisdale Revolving Semaphore Co., Boston.—Full size electric semaphore, wired and in working order.

American Steel Car Wheel Co., Boston.—Car wheel.

Harrison Loring, Boston.—The Jewett freight car truck.

Curley & Bailey, Troy, N. Y.—Models of link and pin coupler and steam coupler.

Dreher Mfg. Co., New York.—Samples of Dreher's railroad compounds for lubrication.

Standard Thermometer Co., Peabody, Mass.—A fine display of thermometers.

Johnson Electric Service Co., Milwaukee, Wis.—Car heating and regulating apparatus.

Thomas V. Johnson, New York.—Samples of embossed leather.

The Safety Car Heating & Lighting Co., New York.—Coupler for heating; also, 16-section Wagner palace car lighted by the Pintsch system of compressed gas.

John H. Harrington, 17 Reynold street, New Bedford, Mass.—Coupler for steam heating.

Richmond Weather Strip Co., Richmond, Ind.—The Richmond weather strip for bottoms of passenger car doors.

G. Rainnie, St. John, N. B.—Safety appliance for car trucks.

The McConway & Torley Co., Pittsburgh, Pa.—Chart, showing the roads upon which the Janney coupler is in use.

Safford's safety draw bar, Phœnix Building, Chicago.—Safford's draw bar.

Marden Car Brake Co., 101 Milk street, Boston.—Marden's steel brake beam.

Bradley & Co., Syracuse, N. Y.—Models of the Bradley cushioned hammer.

The United States Car, Fire & Light Extinguisher Co., 54 Equitable Building, Boston.—Model of the Berry light and fire extinguisher.

Globe Ventilator Co., Troy, N. Y.—A dust guard for passenger car windows, also car equipped with same.

Drake & Wiers, Cleveland, O.—Winslow's Patent Asphalt Car Roofing.

Arnolds Retardation Indicator, 203 River street, Troy, N. Y.

Our Directory.

We note the following changes since our last issue. Our readers will do us a great favor by giving us prompt notice of any changes that may come to their knowledge or of any error that may be noticed in our list.

Chicago & Alton.—A. W. Quackenbush has been appointed superintendent of machinery in place of Wm. Wilson, resigned.

Cairo, Vincennes & Chicago.—Norton Alexander has been appointed superintendent, to succeed C. E. Doyle, resigned.

Central Ontario.—Robert Fraser has been appointed superintendent, vice G. W. Dench, resigned. His headquarters will be in Trenton, Ont.

Cincinnati, Indianapolis, St. Louis & Chicago.—John Roberts, formerly master mechanic of the "Bee line," at the Brightwood shops, is acting master mechanic of the shops at Cincinnati, vice J. S. Patterson, resigned.

Chicago, Milwaukee & St. Paul.—J. W. Stapleton has been appointed superintendent of the James River division, to succeed E. W. Hadley.

Meridian, Waterbury & Connecticut River.—F. B. Hurlbut has been appointed master car-builder, with headquarters at Meridian, Conn.

Mexican National.—Theo. D. Kline has been appointed general superintendent of the entire line, with headquarters, for the present, at Laredo, Texas.

Rome & Decatur.—George D. Lawrence has been appointed general manager of this road, with office at Rome, Ga.

St. Joseph Terminal.—W. P. Harris having resigned, J. P. O'Brien has been appointed superintendent, with headquarters at St. Joseph, Mo.

Wisconsin Central.—S. R. Ainslee has been chosen general manager to succeed W. S. Mellen, resigned, to become general Manager of the Northern Pacific.

G. Campbell, general manager of the Green Bay, Winona & St. Paul, has been appointed general superintendent, to succeed A. A. Allen, resigned, to become general manager of the Chicago & Great Western.

NATIONAL CAR AND LOCOMOTIVE BUILDER

AUGUST, 1889.

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The Baldwin Works are building nineteen locomotives for the Wilmington & Welden.

The Richmond & Danville have placed an order for three locomotives with the Pittsburgh Locomotive Works.

The Rhode Island Locomotive Works are building twelve consolidation locomotives for the Fitchburg Railroad and two eight-wheel engines for the East & West Alabama.

The New York, Providence & Boston Company have lately contracted for the construction of fifty express freight cars, similar to those built a year ago for the New York, New Haven & Hartford.

Last month a redwood was cut down by the Duncans Mills Lumber Company, San Francisco, that was three hundred and ten feet high, and measured thirty-eight feet in girth two feet from the ground.

The average length of life of the tubes on the locomotives of the Northern Railway of France is 234,000 kilometers (145,080 miles) for new tubes and 190,000 kilometers (117,800 miles) for those that have been repaired.

The tubular steel passenger car which we have several times referred to as being under construction at Boston has been sent to Laconia to have the inside fittings put up. The car will be finished in a handsome style, with non-combustible fittings and upholstering.

A cattle train on the Burlington road on July 4 made the run from Kansas City, Mo., to Quincy, Ill., in eight hours, which is said to be the fastest run on record for a live stock train. The distance is 226 miles, which would make the speed 28¼ miles per hour.

The Otis Iron and Steel Company, of Cleveland, O., has been organized into an English company, with a capital of £900,000. Shares of the new company have been offered to the public through the Trustees, Executors and Securities Insurance Corporation. The issue is divided into £300,000 first mortgage debentures, £300,000 8 per cent. preference shares and £300,000 ordinary stock.

According to all accounts, important progress in the matter of electric power transmission is being made in Austro-Hungary. Water power is largely employed for driving the dynamos, and the distances over which the electric current is led range up to two miles. The installations make up in number what they lack in extent, and afford some illustration of the growing popularity of the system.

The Centropolis Car Company, of Centropolis, Kan., will increase its capital stock from $120,000 to $250,000. The company will begin building cars in about 30 days. The foundry department has been running some time, and is now working on castings for the Denver City cable cars The company has been permanently organized by the election of S. J. Shoop as president, and J. J. Baughman as secretary and treasurer.

The New York Central & Hudson River Railroad are about to let contracts for 56 new locomotives. The number will include 50 freight engines, with six wheels coupled, and cylinders 19 × 26, weighing 60 tons each; five passenger engines for local service on the Harlem Division, ordinary American type, 17 × 24 in. cylinders, weighing 42½ tons each; and one dummy engine, for hauling freight on the New York city street tracks.

A queer accident happened at Stetson recently, in the explosion of a piston-head of a steamboat cylinder. The piston-head was being heated at the Globe Iron Works, San Francisco, and was lying in a big fire in a forge. The water in the head made steam and blew the piston-head into many pieces, some of them tearing through the roof. The explosion was heard several blocks away. The men working at the fire were covered with dirt and ashes from the forge, but none were hurt.

A suit has been begun in the United States Court, at Chicago, by the Pullman Palace Car Company, against the Wagner Palace Car Company and the Michigan Central. The Pullman company now claims to cover by its patents the entire vestibule. Suit has also been entered at Boston against the Boston & Albany. Former suits have resulted in a decree restraining other companies from the use of the buffer controlled by the Pullman company, but have not prevented the successful use of the vestibule itself.

Trials conducted with an electric locomotive recently completed for work in the coal mines at Wharncliffe, England, having given the following data: On grade of 1 in 70 the engine was just capable of moving a train of 20 loaded cars, weighing together about 120 tons. With a train of 15 cars, weighing 93 tons, a speed of about 2.7 miles per hour was realized. A 1,000-volt current was used. On grades of 1 in 40 and 1 in 25, with loads of 40 and 30 tons, respectively, a speed of nearly 2 miles per hour was obtained. On a level stretch the maximum weight which could be pulled was a little over 180 tons. The locomotive itself weighed only 2.5 tons, and was operated on the accumulator plan.

Orders for freight equipment recently placed by the Northern Pacific are among the heaviest of the year. The cars just ordered are of four classes, and aggregate 2,400, in addition to the orders placed earlier in the season for 500 furniture cars. Of these, the Peninsula Car Company, of Detroit, Mich., are building 400, and the La Fayette Car Company, of La Fayette, Ind., 100. The orders just placed are distributed as follows: Peninsular Car Company, Detroit, 370 box, 300 stock, 300 flat and 300 gondola coal; Barney & Smith Manufacturing Company, Dayton, Ohio, 430 box; United States Rolling Stock Company, 350 box; Wells & French Car Company, Chicago, 350 box.—*Northwestern Railroader.*

The relative hardness of woods is calculated by the hickory, which is the toughest. Estimating that at 100, we get for pignut hickory, 86; white oak, 84; white ash, 77; dogwood, 74; scrub oak, 73; white hazel, 72; apple tree, 70; red oak, 69; white beech, 65; black walnut, 65; black birch, 62; yellow and black oak, 60; hard maple, 56; white elm, 58; red cedar, 56; cherry, 55; yellow pine, 53; chestnut, 52; yellow poplar, 51; butternut and white birch, 43, and white pine, 35. According to this formula, woods possessing a degree of hardness equal to only about 40 per cent., or less than that of hickory, should not be classed as hard woods. Such woods are, however, limited in quantity, and are not of sufficient importance to justify a classification, and the trade will continue to construe hard wood to mean everything except white pine.

British railway journals sometimes speak out bravely about the defects and inconveniencies of the rolling stock that custom has approved as being most suitable for the tastes and habits of British travelers. Another outrage has been committed in a compartment carriage, and the *Railway Press* thus comments on the incident and the conditions which make such actions possible: The attempted murder of a young lady in a railway carriage at Devizes last week once more exemplifies the danger of the idiotic and antiquated compartment system to which our railway companies, and some sections of the traveling public, still cling so fondly. It is probable that no change will be made in the present system until a duke or a director has been killed, assaulted or robbed while traveling in a compartment alone with some desperate criminal or madman.

The Chicago & Northwestern are using a kind of automatic metallic piston rod and valve stem packing, invented by Joseph Cockfield and C. D. Higgins, of Boone, Ia. Mr. Cockfield, who is division master mechanic, writing to us about the packing, says: This device has been in use for two years on engines belonging to this company and gives entire satisfaction. It is automatic in its action, it is operated by steam in confining the rings to the rods, it needs no adjustment by engineers. When the steam is shut off the pressure on the rods is released at once, leaving the rods perfectly free from friction. He says that the packing adjusts itself to the rise and fall of the rods, working equally well on valve stems and piston rods. It can be made very cheaply, there being very little machine work on it, most of the parts being cast and used direct from the molds.

The Buffalo, Rochester & Pittsburgh introduced premiums to enginemen for coal and oil saving about six months ago. When the system was first introduced only one engineer on the road was able to run his engine with less than the allowance of coal. Nearly all the crews now earn premiums, and a very material saving of fuel has resulted to the company. The men get half the value of the coal saved and the company the other half. The engines are much better fired since the premium system got into good working order, and there is not nearly so much smoke to be seen issuing from the smoke stacks of the engines as there used to be. Many enginemen persist in believing that the prevention of smoke is impossible, but when they receive strong inducements to do the work with the least possible expenditure of fuel, they generally give practical demonstration that the smoke nuisance can be almost entirely abated.

The Northern Pacific road has received two colonist sleeping cars from Barney, Smith & Co., of Dayton, O. Each car has 14 sections, with gentlemen's toilet room in one end and the ladies' room in the other. In one end of the car is a fire-proof heater, and in the opposite end is a cooking range with good cooking facilities. Opposite this range is a 20-gallon cooler for drinking water, besides a large tank holding 70 gallons of water for general use. The sections are separated by sliding head boards instead of wire netting, as in the ordinary car of this class. There is a box under each seat for storing bedding or light baggage, and each section is provided with a movable table. There is a porter in charge of each one of these cars, which are for the free use of all holders of Montana and Pacific coast tickets. With these late additions, the Northern Pacific has sixty-three of these colonist sleepers in use.

The Wisconsin Central's immense train house now in course of construction, between Harrison and Polk streets and west of Fifth avenue, in Chicago, will have one of the most elaborate electric light plants in use in railroading. The train house itself is 560 feet long, 120 feet wide, and 90 feet high. East of this train house, alongFifth avenue, will be the offices, waiting rooms, baggage rooms, etc., and this building will also be lighted by electricity. The plant will be placed under the main building. The system to be used has not yet been decided upon. Both arc and incandescent lights will be used. At present it is intended to arrange a row of incandescent lamps around the building just beneath the roof, with a strong reflector behind them. In the centre of the train house arc lamps will be suspended. In the waiting rooms and baggage rooms and at the entrances arc lamps will be used, and incandescent lamps utilized in the offices throughout the building.

The Mexican National Railway will have the immense car-works and machine-shops at Laredo, Texas, completed within 60 days. The buildings are constructed of Laredo brick, with iron truss roofs. The total cost of this plant will be over $600,000, and it will employ over 1,000 workmen. On the completion of these machine-shops the machinery now in the shops at Corpus Christi, Texas, and New Laredo, Mexico, will be removed to Laredo. It is the intention of the National to concentrate in that city the entire work of their system from the city of Mexico to Corpus Christi, Texas. During the past 18 months enterprises have been inaugurated in the same city involving millions of dollars of Northern and Eastern capital, which has been attracted to Laredo by its abundance of raw material, cheap labor, superior coal and fine water-power, by the possession of which it is destined to become a great manufacturing city.—*Iron Age.*

The Commissioner of Patents has just decided on the final appeal the case of the patents on the cast steel car wheel in favor of the Fowler Cast Steel Car Wheel Co., of Chicago. The decision affirms that of the Board of Examiners and of Examiner of Interferences. It is said that after the Fowler wheel had been publicly produced, the Pittsburgh company began producing car wheels of a substantially similar character, and by methods secured under the Fowler patents. The Pittsburgh company subsequently became the assignee of Clifton B. Beach, of Cleveland, O., who had before received certain letters patent pertaining to car wheels of a different type. The Commissioner in his decision says that an interval of nearly four years had elapsed between the abandonment of the claims of Beach's first application and the filing of the application involved in this interference. Meanwhile Fowler had conceived the invention in controversy, reduced it to practice, entered upon the use of it on an extensive scale and applied for and obtained a patent. Therefore the decision was rendered in favor of the Fowler Company.

The British Parliament has passed a boiler inspection bill which might with great advantage be made a model of bills for all our States. The bill provides for the compulsory periodical inspection, at the cost of, and on the responsibility of, the boiler user, of all boilers to which the act applies; and also for registration in a government department of all such boilers, at a small fee, deemed sufficient to cover the expense of administering the act. Any person working a boiler, for which he cannot produce a certificate from a duly qualified engineer, as defined in the act, is subject to certain penalties, but the boiler-user is at liberty to select any engineer he chooses to furnish the certificate. The investigation of explosions of land boilers is dealt with by the Home Secretary's Department, as the inspector of mines, and also of factories who are to assist in carrying out the provisions of the act, are attached to the Home Office. Both preliminary inquiries and formal investigations must be conducted in open court. No insurance company is allowed to grant a policy of insurance or a certificate for any boiler without proper inspection, and a policy becomes void on the expiration or cancellation of the certificate granted by such company.

SHOP AND ENGINEERING NOTES.

Editorial Correspondence.

Fifteen years ago this month (July) I made my first railroad journey on the American continent, and by the merest chance I patronized the Erie. I was very leisurely and deliberate in my movements, rather too leisurely in fact, for I found time and inclination to stop off at every town where there was reputed to be a machine shop, not for the purpose of going to see if they had anything new to write about, but to ask if they were inclined to take on a new man. The experiences of what proved a long search are not of interest to our readers, further than that I am now able to make comparisons, for the journey gave me excellent opportunities to see the great Erie railroad and to study the methods in which it was operated. I made a journey over the same route last month, beginning almost on the same day, and I found myself constantly comparing what I saw, or had the impression of seeing, in 1874, with the condition of things on the Erie at present. Having been an entire stranger in a strange land, I was keeping my mental vision open for impressions, and one of the first indelible, non-erasible marks put upon my outer consciousness was that an Erie conductor was an exceedingly great man, and that being civil to the people he conducted over the State was not regarded as a part of his duty. I had the audacity to apply to several conductors for information not relating to the time of arrival or departure of the trains, and in each case I was treated with such curt rudeness that I naturally concluded boorishness, combined with stupid affectation of high authority, to be essential to the comfortable walk and conversation of the man who had charge of an American passenger train. I found reason to modify this opinion as my experience extended, but for years there remained an impression that the Erie railroad belonged to the passenger conductors, and really my tender-foot conclusions were not so very far wrong.

The next memorable impression was how outlandish the names of the stations are as shouted by the brakemen; then I suspected they were calling the names in Welsh, to make them plain to some miners who were in the car; but I found in this case the mistake was mine, in not having learned the New Jersey English of the period. How slowly the trains run, how hard the locomotives labor in getting the trains away from stations and up grades, were impressions caused by contrast with the faster British trains and the larger nozzles in locomotives with which I had been familiar. How so many trains were moved safely on a single track appeared a mystery.

I had never traveled on the Erie east of Hornellsville except at night, and in a sleeping car, since my first journey, till I took the trip last month, and then I chose day trains, that I might see the road and watch the methods of working the train service. I traveled on different divisions during part of five days, and I looked keenly for some of the old-time conductors, but it seemed that all the grand moguls of this class had got the blue envelope, or something had inspired them to change their ancient habits. A train that I went with from Jersey City to Susquehanna, in charge of a man named Welch, was the best conducted train I ever traveled on. He appeared to keep the run of the stations where all the passengers had to get out, and every one appeared to be notified when they had to get out at the approaching station. The names of the stations were distinctly called, and conductor and brakeman busied themselves giving assistance in getting off the train to passengers needing help, such as women with children or hand baggage. Although there were many way passengers, some of the stops at stations were less than 20 seconds, the conductor being ready with the signal when the last passenger had alighted.

All the conductors met with on the trip were not so energetic or efficient as the first one, but all of them were civil and attentive to their passengers, which is a very desirable change. The cars are clean and well lighted, the trains are run at the speed now prevalent on first-class roads, the track is all double, and all stations are supposed to be protected by semaphore signals. I use the expression "supposed to be" advisedly, for I repeatedly noticed that, although the signals were there, the arm was not raised while the train remained at a station. A good signal system ought to make trains standing at stations quite safe from tail-end collisions, but if the signals provided are not operated they are worse than useless—they act the part of a false beacon.

One thing I found unchanged. The bold mountains, the far spreading forests, the clear flowing rivers, and the emerald vales that make up the leading features of the beautiful scenes traversed by the Erie Railroad, are still there in all their picturesque grandeur. I have rambled, filled with enjoyment, through many scenes whose beauty has been the theme of poets' lays, and stood on historic ground awed with the majesty of nature clad in the wildest garbs, but I have never found scenery more varied, attractive and beautiful than that to be seen between Paterson and Binghamton. Every minute brings a new panel scene through the car window, and hundreds of the views appear to be aiming to surpass each other in beauty and in grandeur.

SUSQUEHANNA SHOPS.

The mechanical headquarters of the Erie are at Susquehanna, and here are to be found the main shops of the system. How the main shops came to be located in such a place is one of the Dundreary mysteries—"something which no fellah can understand." There are some places on the main line where nature would have presented greater obstacles to the building up of shops and their necessary adjuncts, but not many. If the powers that controlled the Erie in the days when the shops were built wanted to show what they could do in the way of defying nature, they succeeded fairly well. Their successors, however, will have to do very expensive defying to make much extension of the shops and yards. The main part of the establishment consists of a very large oblong single story building, which forms the machine shop and erecting shop. This building is long enough to provide 21 stalls, set side by side, with ample room between them, and it is wide enough to cover, besides the stalls and an ample machinery floor, a transfer track that holds an engine. The exact dimensions are 600 × 150, a very large shop. The boiler shop and the blacksmith shop are wings built at right angles to the machine shop, and the round house is at the end. The general plan of the shops is good, and the buildings have been very substantially erected. The weak point about the shop has been the want of proper facilities for handling material, but this source of inconvenience is being remedied by the introduction of carrying tracks, and cranes, and hoists. They have a fine equipment of excellent tools in the shop, but many of them were inconveniently located, and Mr. W. Lavery, the able master mechanic in charge of the shops, has been rearranging them, and the changes made have decidedly improved the facilities for handling work. Mr. Lavery is an old Pan Handle man, and he has had long experience in managing the piece-work system in railroad machine shops, and appears to be thoroughly conversant with its merits and shortcomings. The piece-work system has been abolished in the Susquehanna shops.

Former managements of the Erie evidently intended that the Susquehanna shops should be made the manufacturing establishment for the road, and they provided the best machinery and plant then on the market for carrying on the business of builders of rolling stock. The important business of maintaining the rolling stock in first-class order was made a secondary consideration, and the work was in a great measure relegated to division shops scattered all over the system and deficient in proper facilities for doing work. The consequence was that they had fairly good building shops which could not compete with regular manufacturers' prices, and inferior repair shops that carried on the work at great expense, and were chronically behind with it. Of late years a new policy has been inaugurated, and keeping existing rolling stock in running order is made the primary business of the shops. The aim is to concentrate the work in a few large shops, and close up the small ones, or merely confine them to light running repairs. All additions to machinery are made by purchase from makers. Under this policy, Susquehanna, instead of being the manufacturing center, is the headquarters of repairing. They are doing a great deal of necessary work, and the effect of the new policy can be seen in the improved appearance of the engines and cars belonging to the company.

When I visited Susquehanna there were eighteen engines in the repair shop, and they were turning them out at the rate of about one a day. Engines that are repaired under the day pay system are said to remain on the road much longer than those that are repaired under the piece work system, and they need less running repairs to maintain them in service. The work of repairing is carried on in a highly systematic manner. Engines are moved in and out very quietly on a steam-operated transfer-table, which has appliances that enable two men to do all the work without the aid of any of the shop hands. When an engine gets into a repairing stall, a gang of strippers take all the parts down that have to be removed. All greasy parts are taken to what is called the "laundry," a large, oblong vat, located near the middle of the shop, between two stalls. The vat is heated with steam, and contains a mixture of water and lye, which quickly cleans off all grease. The parts requiring repairs are then sent to the place where the work is done, and the parts that need no repairs are marked and placed in a covered pit beside the stall where the engine stands. When the boiler of a standard engine has to be moved to the boiler-shop for the putting in of a new fire-box or for receiving repairs that will cause much delay, the intention is to keep a spare boiler that can be put right on and the engine got ready without the delay that results so often and keeps many engines out of service. This is a plan that other shops might follow with advantage. A form of fire-box introduced as an improvement has been materially increasing the boiler work. The side sheets were extended above the crown far enough to form a rest for the crown-bars. That of course left a protected space along the top sides of the crown which filled up with mud and led to the burning of the sheets. I have repeatedly heard this "improvement" advocated. Those who are disposed to try it had better see that special provision is made to prevent mud burning.

While looking round at the work going on, I found that they were putting close-bottomed ash-pans on all engines that formerly had hopper bottoms, that admitted of cleaning on the road. They found that it was impossible to prevent fire raising when the self-dumping ash-pans were used. I also noticed that the new ash-pans were very substantially made and the doors well fitted. Another thing which they are doing is a novelty to me. They are putting shaker grates into all the hard coal burning engines, those with the Wootten fire-box included. The only change they make from the soft coal burners is to arrange for one section of the grates to be shaken at once. Hard coal burning engines that have been running for some time with shaker grates are said to be greatly improved steamers toward the end of a journey.

They have several heavy Wootten mogul engines running out of Susquehanna pulling heavy fast passenger trains. The men who are responsible for getting the trains over the road on time speak in the very highest terms of the efficiency of these engines. They pull 13 or 14 heavy passenger cars with ease over the steepest grades and make the running time. They are said to be splendid steamers, and ride as smoothly as a sleeping-car. The leading dimensions of the engines are: Cylinders, 20 by 24 inches, and driving wheels 68 inches in diameter. The engines weigh in working order 118,700 pounds, of which 36,600 is on the leading drivers, 33,200 pounds on the middle drivers, and 31,200 pounds on the back drivers and 17,700 pounds on the truck. As many master mechanics are watching the performance of mogul engines on heavy fast passenger service with a view to trying them, I paid particular attention to ascertaining the merits and drawbacks of the engines which I saw at Susquehanna. They appear to be as safe as eight-wheel engines. There is no trouble experienced with the rods, and the expense of repairs is moderate. These engines have given considerable trouble with their frames and guide yokes, but it is understood to have been caused by the boiler standing so high that its swaying puts severe torsional strains on the fastenings. They have found a remedy in strengthening the guide yokes and bracing them to the boiler, which has had the effect of preventing the buckling action of the frames in the middle, as the guide yokes are made to brace the boiler to the frame.

Near the middle of the shop they have a double fire furnace for the tool dressers. It is an extremely neat inclosed furnace, and besides the fires it has fire-clay tubes for the annealing of tool steel, the heat being furnished by the waste gases. There is also connected with it a box for tempering Mushet steel in an air current. All tools dressed are sent to the tool-room to be ground, and it is through the same place that all fixing up of tools is done. They have a well-arranged tool-room fairly stocked with small tools and templates. They are preparing a separate place for the storage of templates. Boys are kept in the tool-room for carrying the tools to and from the workmen, annunciators being placed at convenient points where men can send requests for anything wanted. The plan is said to have worked very well, but is a little hard on the sojering mechanic, as it greatly reduces his supply of excuses for leaving his work. There are clothes-presses provided for the workmen, where each man can hang his clothes and other articles, and lock them up securely. In one part of the shop there is a full equipment of air-brake apparatus, set up so that trainmen may receive instruction in the handling of everything pertaining to power brakes.

The principal drawing office of the road is here, and is admirably managed by Mr. S. H. Harrington, chief draughtsman. There are so many things to say about Mr. Harrington's work that for want of space I must put off writing about it. Mr. Lavery is assisted by a very intelligent staff of foremen and gang bosses.

BUFFALO, ROCHESTER & PITTSBURGH SHOPS.

From Susquehanna I went to Rochester, and my first visit there was to the shops of the Buffalo, Rochester & Pittsburgh, where Mr. Dolbeer is superintendent of motive power. Some years ago I went to Renova, Pa., to visit the Pennsylvania shops there, where I was informed that the most successful system of shop piece work to be found in any repair shop was in operation. On going there, I found that Mr. Dolbeer was general shop foreman, and a day spent in the shops gave me the impression that many of the important details of the system used originated with him, and that to his striking executive ability was due much of the success of the system. There appeared to me to be some highly objectionable features about the piece-work system as applied to a repair shop, and I tried to ascertain Mr. Dolbeer's private views on the subject, but he was extremely non-committal. I had met few better mechanics, and he displayed a penetration and breadth of grasp on most subjects which convinced me that immediate and superficial advantages would not blind him to the fact if the piece-work system tended to shorten the performance of engines or cars between the periods of repairs. So I was very anxious to see what Mr. Dolbeer was doing with the Rochester shops, where he was presumably left to follow his own judgment as to the system of repairs which was best for the interests of the company. I was unfortunate enough to go to Rochester when he was away on a trip over the road, but I found Mr. J. F. Braden, the general foreman, who is an old Renova man, and he did not display any reticence in discussing all the shortcomings of the piece-work system. They are doing all their work on the Buffalo, Rochester & Pittsburgh, in both the locomotive and car departments, by day work, and the responsible officers are prepared to show that in so doing they are following the most economical course. The work is, however, carried on in a highly systematic manner, and the method of shop orders in vogue in most piece-work shops has been adopted here.

There is not much about the shops that would be worthy of imitation, except that by the use of a good system of

working and some good tools a great deal of work is done with comparatively few men, and in spite of natural obstacles. The shops are in the transition stage of development where car and locomotive work is not distinctly separated. The machine shop has iron working tools on one side and a planing mill on the other. This makes an inconvenient arrangement, for the wood dust makes the belts of the iron-working machines slip; but those in charge seem contented to make the best of it till it becomes convenient to make a more distinct separation of the two lines of machinery.

The business done by the company is mostly the hauling of coal, coke and other heavy freight, and the standard engine used for doing the work is of the consolidation type. Like many other railroad companies, the Buffalo, Rochester & Pittsburgh chose consolidation engines with very small wheels, and they are now finding out that a serious mistake was made. They have a considerable number of these engines with wheels 44 inches diameter. Other engines with larger wheels and about the same cylinder power proved much easier on repairs, and now the company are increasing the size of the small driving wheels by leaving on a ring two inches thick made of old tires. The engines are reported to be decidedly improved by this change.

The question of what is the best form of brass or bearing for locomotive driving boxes has received a great deal of practical attention here, where every effort is being made to keep down the expense of repairs and yet maintain the engines in good order. Various mixtures of brass and bronze have been tried, but experience is urging them toward the general adoption of the old Brooks bearing, which consisted of three brass gibs, with a filling of soft metal between. I saw some boxes of this kind on the floor that had been in hard freight service for nine months, and they were in such good order that all the work necessary before putting them back was crowning out a little.

I noticed that they were applying the American steam brake to a great many of the engines, and it is the intention to have power brakes on every locomotive belonging to the company. They are also putting extensive smoke-boxes on all engines, and getting the whole of the motive power into first-class condition. They are thoroughly overhauling four engines a month, and doing light repairs on two more.

Mr. Dolbeer, who was a great believer in the fuel-saving effect of the coal premium system as practiced on the Pennsylvania, has introduced it here, and the reduction of fuel resulting has been remarkable. All locomotives belonging to the road are using slack coal, and they burn very little more of it than they do lump coal. No special provision of fire-box or grates is made to burn the slack. They do not expect to be able to burn the slack in winter with common fire-boxes.

Mr. H. Weston, foreman of the car department, is thoroughly overhauling 60 freight cars a month. They have just bought four new passenger cars, and they are building some new cabooses and rebuilding several others. A large shed has lately been erected where the repairing of freight cars will be done. The car department has its operations restrained, the same as all other departments of the road, within certain limits presented by the determination of the management to put the property on a paying basis.

The trainmen on this road are paid on a peculiar system worked out by Mr. Riley, assistant to the president. All those who have had anything to do with the payment of trainmen are aware that neither a mileage nor a day system of pay is entirely satisfactory. The men here are paid on a combination of the two systems, and it is said to work very satisfactorily. An engineer gets 25 cents an hour, a fireman 13 cents, a conductor 19 cents, and brakemen get 12 cents. In addition to that each of these men gets a certain sum for the run made, the combined rates amounting to about the current pay of the district. The hour basis is an advantage to those who are on slow trains or on runs subject to delays.

ROCHESTER CAR WHEEL WORKS.

While in Rochester, I paid a visit to the Rochester Car Wheel Works, and watched the making of wheels with the Barr chill. They have finely-designed works, with the most approved facilities for handling the material, for annealing the wheels and for handling the finished wheels. They have capacity for casting 200 wheels a day, and their business is so good that they talk of increasing their plant. Mr. Charles T. Chapin, president and treasurer of the company, is extremely enthusiastic about the future of wheels cast in the contracting chill, and he certainly has adopted the sound business policy of making a wheel with merit sufficient to secure popularity. I timed the pouring of several of the wheels, and found it ran from 10 to 15 seconds. Wheels poured in an ordinary mold in that time would be ruined with chill cracks, but all these came out with fine, clean, spotless treads. The process produces a very deep chill, a perfectly round wheel and an extremely strong wheel, but I suppose the latter merit is due to the good mixture of iron used. To show me a test of strength of the wheel, Mr. Chapin directed the foreman to take one and break it under the drop. The drop used was the well-known Pennsylvania test of 140 pounds, falling twelve feet upon the hub of the wheel, the requirement being that the wheel shall stand five blows before breaking. The wheel I saw broken stood twenty-two blows before it showed a crack.

The wheels made in the contracting chill have small fin-ridges on the tread, which some railroad companies object to, as it makes the wheel noisy. All wheels manufactured in the Rochester Car Wheel Works have these fins ground off, and the work is done in a most simple and expeditious manner. The wheel is placed vertically in a revolving chuck, and an emery block fastened to a lever is pressed upon the top of the revolving wheel. In a few minutes the wheel is as smooth as a turned tire. One man can smooth up ten wheels an hour in this way. For wheels that have to be ground perfectly true they have a more elaborate method. They use a grinding machine invented by Mr. J. N. Barr, in which the wheel is embraced and revolved by three rollers set in the form of a triangle. As it turns the tread is worked upon by an emery wheel. The wheels finished in this way have a beautifully smooth tread; but to me the work looked like painting the lily.

THE MARTIN CAR HEATER WORKS.

My next stopping point was Dunkirk, and the first place visited there was the works lately finished by the Martin Anti-fire Car-Heater Company for the manufacture of the appliances used by the company. The business of heating cars by steam is yet in its infancy, but the Martin people informed me that they have already applied their system to 2,661 cars and 887 locomotives. This is considerably different from what they were credited with in the very defective report on car-heating submitted to the Master Car-Builders' Convention, but I believe it to be correct, and it is said to cover close on nine per cent. of the whole passenger cars in the country. The works which the Martin Company have put up at Dunkirk are on a scale that could grapple the business of equipping the whole remaining passenger cars with heating apparatus and make quick time with the work. They already have a capacity equal to supplying all the fittings for 50 cars every fifteen hours, and their output could easily be doubled. The main building is of brick, 114 × 50 feet and three stories high. There is in addition to that an iron foundry 40 × 80 feet, a brass foundry 40 × 80 feet and a blacksmith shop 20 × 40 feet. The works are situated close to the main line of the Lake Shore & Michigan Central, and they have a spur track which brings cars alongside of an elevator connected with the main building, which reduces to the lowest limits the delay and expense of handling freight.

They have organized the method of manufacturing all details of the apparatus used in car-heating on a thoroughly systematic basis, special tools being provided for nearly every distinct operation. The president of the company, Mr. William Martin, is himself a practical mechanic, and no one knows better the advantage of doing the work by the most advanced modern methods, and he has selected highly efficient assistants for carrying on the work. The mechanical superintendent of the works, Mr. D. A. Barnes, is a very ingenious designer of special tools, and the greater part of those in use in the shop are of his invention. There is a very simple and efficient machine for turning the globular fittings of the coupler used, another machine mills the wrench notches in coupling-nuts. Most of the operations connected with the manufacture of the metallic coupling, and of a most efficient reducing valve they are making, are performed by special tools, and the greater part of the work on pipe fittings, cutting, threading, etc., is done by appliances designed to quicken the work and to improve its quality. All parts are finished to templates, and are as strictly interchangeable as the parts of Westinghouse brake apparatus.

All the shops are models of neatness, and the equipment is all of the most approved kind. The iron foundry has a six-tons Colliau cupola, made by Byram & Co., Detroit, which is said to run metal ten minutes after firing. They have been experimenting considerably to find the metal most suitable for strong light fittings, and they have got metal of a very high tensile strength adapted for small castings. In the brass foundry they use natural draught, with well designed brass melting furnaces. An idea of the work done here may be formed from the fact that in their busy time last fall they used up twelve tons of pure copper in two weeks. Among orders given out during their busy season was one for 150,000 feet of pipe wrappings and another for $27,000 worth of three-way cocks.

The machinery is run by a Rice engine, and the electricity for incandescent electric lights is generated by a dynamo driven by the engine.

Mr. Martin is emphatically in favor of direct steam for the heating of cars, and thinks that there is really no difficulty in regulating his system to suit the requirements of any climate or any kind of weather, but the officials of several roads have been persistently urging him to apply his system to the operating of the water connections of the Baker heater, and he has at last consented to do so. He has designed a very neat arrangement for operating the Baker heater medium by steam or for using a fire when steam is not available. It consists of a steel cylinder that can be put into the space occupied by the Baker furnace. Inside of the cylinder is a fire-box, and between the fire and the outer shell is a water space which holds upright tubes for the gases from the fire to pass through and heat the water when a fire is used. It also contains a coil of piping through which the steam is passed when it is desired to use steam for heating and circulating the water in the Baker pipes. I happened there the day they were making the first trial of this apparatus. They had connected with the cylinder the same length of piping generally used in a sleeping car. Connection was made with a pipe from a stationary boiler to the cylinder, and in ten minutes the hot water was circulating through the whole circuit of the car pipes. There is every reason to believe that this auxiliary heater will become popular with those who do not believe in direct steam heating.

THE BROOKS LOCOMOTIVE WORKS.

During a brief visit which I paid to the Brooks Locomotive Works, I found that they were putting a new iron truss roof upon the erecting shop, and in connection with it they are introducing various improvements calculated to facilitate the work. They are also putting in a new hydraulic riveting plant with the boiler shop, which is already admirably equipped with machinery for boiler-making. When the improvements going on in these works are completed, which will be within this month, they will have a capacity of one locomotive a day. An extension has been made to the office building for the accommodation of a laboratory, where all material used in the works will be tested. The business in the works has been dull for several months, but orders are now coming in a way that promises a busy fall. They have had several new tools put in, among which I noticed a Brown & Sharpe universal grinding machine, and two turret lathes for stud-making. They are highly pleased with the work done by the Sellers tool grinding machine, which they have had at work for some time, and the tool-grinding for all the workmen in the shop is now done on it. They have several new boilers in the shop that have triple-riveted horizontal lap joints. This was the first job of the kind I have ever seen on locomotive boilers. It appears to be a very strong joint, and is said to be considerably cheaper than a butt joint with welts.

A. S.

Using Flangeless Wheels in Middle of Six-Wheel Trucks.

We mentioned some time ago, when Mr. W. A. Scott was assistant superintendent of motive power of the Chicago & Northwestern Railway, that he was experimenting with flangeless wheels for the six-wheel trucks used under passenger cars with encouraging promise of producing a six-wheel truck that would effect a great saving of tires, while materially reducing the resistance offered by the present truck. The investigations were continued till lately, and have resulted in a design of axle box in combination with one set of wheels with flangeless tires, which has been patented. Trucks with a special box and flangeless wheels have been running on the Chicago & Northwestern and Chicago, St. Paul, Minneapolis & Omaha railways for several years with great saving to the companies.

The economies of this truck are great, as where steel tire is used, at a cost of $30 to $40 per tire, a railroad reduces its entire cost on six-wheel trucks just one-third, because when leading wheels of a truck become flange-worn to an extent that would make it essential to scrap them, all that is now necessary is to take that pair of wheels and turn the flange entirely off, thus leaving tread from 1 inch to 1⅛ inches thick, and enabling same tire to be used flangeless in centre of truck for mileage that will exceed what was formerly obtained with flanges on. Tires are being constantly turned in order to get good flanges, frequently taking off three-eighths of tread for no other purpose than to furnish suitable flange, and often with tread 1⅛ inches thick with flanges cut, the tire must be turned, taking off five-eighths of whole tread to get suitable flange and fillet, thus rendering the tire useless, as 1-inch tread thickness is minimum for safety with most roads. In such a case the Scott truck enables the taking that tire 1⅛ inches thick on tread and turning it off smooth, probably 1½ inches thick, and flangeless, and putting that pair of wheels into middle of truck, where it will wear for four or five hundred thousand miles, thus saving that much mileage to the company, for the tire would, under flange conditions, be useless.

A car with flangeless center wheels requires less motive power to haul it, as on curvatures it does not in any sense bind. Those interested in the flangeless wheel have illustrated this by placing a coach with two six-wheel trucks, all wheels flanged, on a certain curve, and it took 32 men to push it 150 feet; then took a coach of same class and weight with six-wheel trucks, flangeless wheels in center, and 19 men pushed it same distance over same track as easily as the 32 men did the other. Again, when snow conditions obtain on railway tracks, there is on each car four less flanges to be bothered with snow near inside of rail, making hauling of car 30 per cent. easier. And finally, wear on ball of rail is also largely reduced, especially on curves, by use of this truck, as there is one-third less flange bearing to each car, which, of course, wears up against rail in swaying of train much less than if all wheels had flanges.

The New York, Providence & Boston lately ordered six new passenger cars to be built in a contract shop. One of the cars will have an arched roof after a design got out by Mr. L. M. Butler, master mechanic of the company. One car of this kind already in service has a very handsome appearance inside, and gives so much satisfaction that the style is likely to be adopted as standard. The same company has lately ordered from the Rhode Island Works a heavy Forney engine for suburban passenger traffic and a fast heavy freight engine.

Proceedings of Master Car-Builders' Convention.

The annual convention of the Master Car-Builders' Association met at Saratoga, June 25, President James McWood in the chair. The president of the corporation delivered an address welcoming the Master Car-Builders to Saratoga.

The following members were present at the convention: F. D. Adams, B. & A.; La Mott Ames, Beech Creek; William Apps, Atlantic & West Point, Western of Ala. and Cinn., Selma & Mobile; Thos. Anderson, P. & W.; D. W. Ballentine, S. & R.; J. N. Barr, C., M. & St. P.; T. A. Bissell, Wagner Sleeping Car Co.; R. C. Blackall, D. & H. C. Co.; Charles Blackwell; F. P. Boatman, Ohio & Mississippi; F. O. Bray, Lake Shore & Mich. South.; F. G. Brownell, Burlington & Lamoille; H. Boutet; H. S. Bryan, St. Paul; C. J. Butler, Fall Brook Coal Co.; F. D. Casanave, Penn. Co.; E. Chamberlain, N. Y. C. & H. R.; J. W. Cloud, J. S. Cook, G. & G., J. & S.; Wm. Cormack, Wis. Cen.; C. H. Cory, C. H. & D.; John Cowan, Alleghery Valley; J. H. Davis, Wilmington & Weldon; W. H. Day, Wil., Col. & Aug.; G. W. Demerest, Northern Central; C. H. Dickerman, Milton Car Works; T. G. Duncan, Cin., Washington & Bal.; J. B. Fletcher, National Car Co.; M. N. Forney, *Railroad and Engineering Journal;* A. Griggs, P. & W.; J. L. Greatsinger, D. & I. R.; E. Geffcken, S., F. & W.; E. W. Grieves, B. & O.; F. B. Griffith, D. L. & W.; G. H. Harris, P., C. & St. L.; John Hodge, A., T. & S. Fe; D. W. Hunter, P. & W.; E. W. M. Hughes, N. W. R. of India; J. B. Henney, N. Y. & N. E.; S. Irvin, M. P.; A. A. Jackson, N. Y & N. E.; Ross Kells, N. Y., L. E. & W.; John Kirby, L. S. & M. S.; A. M. Kittridge, Barney Mfg. Co.; J. N. Lauder, Old Colony; J. T. Leighton, Baker Heating Co.; W. H. Lewis, C., B. & N.; J. S. Lentz, P. & N. Y. Canal & R. Co.; J. Mackenzie, N. Y., C. & St. L.; J. W. Marden, Fitchburg; M. M. Martin, Wabash; H. C. McCarthy, Pennsylvania Railroad; James McGee, H. & T. C.; J. D. McIlwain, Grand Trunk; R. McKenna, D. L. & W.; Wm. McWood, Grand Trunk; W. D. Minton, T. & P.; G. W. Miller, Buffalo, N. Y.; E. D. Nelson, Penn., P. & E. Div.; G. C. Payne, B., R. & P.; P. H. Peck, Belt R. R., Chicago; John H. Rankin, P. & R.; G. W. Rhodes, C., B. & Q.; D. C. Richardson, B. & M.; J. Richardson, Cin. Southern; S. S. Rigby, C., J. & M.; W. J. Robertson, Cen. Vermont; Chas. A. Schroyer, C. & N.; W. P. Siddons, International & Gt. Nor.; William A. Short, O. & L.; J. R. Skinner, D. & A. C. Co.; W. T. Small, Nor. Pacific; C. A. Smith, Union Tank Line; B. C. Stoddard, N. Y., L. E. & W.; W. B. Snow, Illinois Central; A. G. Steinbrenner, Am. Refg. Transit Co.; T. B. Stewart, Hartford & Weatherfield H. R.; F. A. Stinard, N. Y. & G.; T. Sutherland, C. & G. T.; J. Townsend, C. & A.; W. H. Thomas, E. T., Va. & Ga.; W. G. Van Buskirk, C. & M.; Wm. Voss; B. K. Verbryck, C., R. I. & P.; J. Voorhees, Ind. Cal. & Mfg. Co.; R. D. Wade, R. & D.; E. B. Wall, P., C. & St. L.; David White, Intercolonial; A. T. Whitehouse; H. A. Whitney, Intercolonial; R. H. Wilbur, Lehigh Valley.

President McWood, in his opening address, expressed pleasure at meeting the members in such a beautiful spot, referred to the useful work done by railroad clubs, dwelt on the beneficent influence the Master Car-Builders' Association had exerted in facilitating the movement of freight over this continent. He hoped that the important subjects to be submitted by the committees would be discussed with the clear purpose of coming to conclusions. He especially urged the necessity for agreeing upon the dimensions of an axle adapted for cars of large capacity. In conclusion, the president bespoke the consideration of the meeting for his shortcomings as a presiding officer, and assured the members that it was his desire to promote in every way the welfare of the Association.

Mr. Rogers, chairman of the New York Board of Railroad Commissioners, at the request of the president, addressed the meeting. Mr. Rogers expressed the high regard which he and his associates entertained for the M. B. C. Association. No organization had been more influential in removing the friction of transportation and in enhancing its safety. The march of progress was rapid. In 1875 the cost of moving freight per ton per mile was 3 cents. In 1888 it was 0.8 of a cent per ton per mile. This economy had been brought about by the efforts of this Association. Great benefits had resulted in the bringing about of standards in everything. The board was aware that state supervision must be in harmony with the railroads to be progressive. The board was in sympathy with the associations. The limit was being reached in carloads of 60,000 lbs. run at high speeds. If more was carried roadbeds and bridges would have to be reconstructed. When the steam-heating law was passed the board hoped that ventilation would also be taken up. It would please the board and the public if the Association would consider this question. It was a simple matter to let the cold air in at the bottom of the cars and then heat it.

Secretary Cloud then read his report, which showed that the Association has 138 active members, 90 representative members and 5 associate members. The finances of the Association were shown to be in a satisfactory condition.

COMMITTEES.

A nominating committee was chosen, consisting of C. H. Schroyer, J. Townsend, B. K. Verbryck, F. D. Adams, E. Chamberlain.

Mr. E. B. Wall moved that a committee be appointed to draw up resolutions regarding the work M. N. Forney had done for the Association. E. B. Wall, G. W. Rhodes and J. S. Lentz were appointed to this committee.

An auditing committee, consisting of J. N. Barr, E. Chamberlain, John MacKenzie.

Mr. Angus Sinclair was elected an associate member.

Messrs. Marden, McIlwain and Schroyer were appointed a committee to report on an amendment to the by-laws regarding the selection of places for holding the annual convention.

Next business taken up was the reading of the reports of committees.

REPORT OF COMMITTEE APPOINTED TO FORMULATE A CODE OF RULES FOR THE INTERCHANGE OF PASSENGER CARS, INCLUDING SLEEPING, PARLOR, CHAIR, BAGGAGE AND EXPRESS CARS.

Your committee appointed to formulate a code of rules for the interchange of passenger cars, including sleeping, parlor, chair, baggage and express cars, offer the following:

After a series of meetings it became apparent to the committee that, in order to formulate and present to this convention a code of rules for such interchange that would be in any wise acceptable, entailed a greater amount of labor than originally anticipated, and considerably more time than your committee could possibly devote to the subject, and if it be your pleasure to weigh this committee in the balance against the code of rules for the interchange of freight cars now in operation, which has required years of labor to bring to even its present state of efficiency—your committee can scarcely report progress.

From the outset it became evident that many obstacles were in our path, and but a casual inquiry evinced the fact that the interchange of passenger equipment was confined almost entirely to drawing room and sleeping cars, performing a through service (in nearly every case such cars carrying an extra stock of brake-shoes, journal bearings and other equipment, peculiar to the construction of the cars, to make the necessary running repairs in case they were needed), and for such services there existed a well-defined code of rules, adopted by the several roads operating these cars, which rules were subject to amendment at the pleasure of the subscribing companies. In addition, it was found that certain mail and baggage cars, and occasionally a passenger coach, performed a through service for the convenience of, and by the consent of, interchanging companies, but even in the latter cases there existed arrangements, connected with the condition of cars, which might be rated of a local nature, but perfectly satisfactory to the several companies interested, and like the drawing room and sleeping car rules were subject to amendment at pleasure. In view of these facts, it was therefore difficult for your committee to formulate a code of rules that would not in a measure conflict with the present local arrangements existing, as hereinbefore stated, and which, so far as we were able to learn, were entirely satisfactory to the interested companies. It would be manifestly unjust to the several companies now interested in an interchange of passenger equipment under rules of their own devising for this committee to recommend any change in the same, and on the other hand, your committee would scarcely presume to offer at this convention for adoption or ratification, or even discussion, by railroad companies who are *not*, those rules which now govern railroad companies who *are* operating drawing room and sleeping cars of any particular line. And to assimilate the rules of the several drawing room and sleeping car lines now operating in this country, so that they would be satisfactory to the railroad companies and car owners, is an undertaking that your present committee were entirely unprepared for. We fear that such an attempt would be fraught with many dangers, and would open wide the door for certain innovations and the application of certain devices on through cars that might be ratified and become a law by a majority vote of disinterested persons, much to the annoyance and dismay of those who were actually placed at the expense of making such changes.

In conclusion, your committee, after careful inquiry, have been unable to find that there is an immediate demand for a code of rules governing the interchange of passenger cars, and, although it may have been the case, they have yet to find an instance where unnecessary delay has been occasioned in such interchange owing to the absence of a general code of rules, unless it be on account of different heights of couplers; consequently we would recommend that the attempt to formulate a code of rules for the interchange of passenger cars, including drawing room and sleeping cars, be, for the present at least, abandoned, unless the Association thinks best to adopt a standard height for draw-bars.

T. A. Bissell,
E. Chamberlain.

The report was received.

Mr. Ross Kells, N. Y., L. E. & Western, thought there ought to be rules for the interchange of passenger cars as well as for freight cars. The Erie now runs cars from Jersey City to Chicago. On runs of this kind the cars have to pass inspections, but there are no recognized rules to guide them. Different master car-builders have very different ideas about the size of flat spots that may be passed and about other matters, and it is sometimes difficult getting payment for repairs.

Mr. E. Chamberlain, New York Central, mentioned that the sleeping car companies already had certain rules regulating the movement of cars and they would not be benefited by a change. It was an exceedingly difficult matter to formulate adequate rules to regulate passenger car interchange.

Mr. F. D. Casanave, Pennsylvania, believed that the present freight car rules should be applicable to passenger cars. Wheels and draw-bars, for instance, are fully covered by present rules.

Mr. W. H. Day, Wilmington & Weldon, agreed with Mr. Casanave, but thought the definition of flat spots on wheels ought to be different for passsenger cars.

Mr. F. D. Adams, Boston & Albany, thought the point at which steel wheels should be rejected would need to be clearly specified, and the thickness of ties should be defined.

Mr. J. N. Burr, Chicago, Milwaukee & St. Paul, was against discussing the question at present. Thought the rules of interchange of freight cars should govern passenger car interchange.

Mr. C. A. Schroyer, Chicago & Northwestern, said that the brake levers of passenger cars required attention. He would not run a passenger car with wheels having slid flat spots.

Mr. T. A. Bissell, Wagner Sleeping Car Company, said that the brake leverage of most cars is regulated according to the Westinghouse methods.

Mr. Day said that they receive passenger cars with different heights of draw-bars, and he thought it very desirable that a standard height be established. They are using 35 inches as height of draw-bars, but would prefer 37 inches.

Secretary Cloud read from the published standards of the Association the statement that 36 inches had been established in 1869 as the standard height of draw-bar for passenger cars.

Mr. John Lentz, Lehigh Valley, said that four years ago he was chairman of a committee that reported on 34½ inches as a standard height for passenger car draw-bars, and it was sent to letter ballot and rejected. Held that there is now no standard.

Mr. Adams was under the impression that 35 inches was the standard height for passenger draw-bar.

Various members gave their impressions as to the standard height of passenger draw-bar, the general impression being that 35 inches was the standard, or ought to be, and then

Mr. Wall made a motion that the committee be continued, and that they be directed to investigate the advisability of changing standard heights of passenger and freight car draw-bars, and to give recommendations for standards.

Mr. J. W. Marden, Fitchburg, directed attention to the necessity for keeping down the center of gravity of cars to permit them to pass through low tunnels.

Mr. Lentz said that a height of 33 inches for the height of freight draw-bars was clearly a standard. He moved that a standard of 35 inches be adopted for passenger cars.

Considerable discussion ensued, and an amendment to strike out the words "and freight" from Mr. Wall's motion was carried, and the motion so amended was adopted.

The report on standard journal box lids was then read as follows:

JOURNAL BOX LIDS.

Gentlemen: Your committee appointed to report on standard journal box lid for a 40,000 and 60,000-lb. car beg to say that they have carefully considered the matter, and have made inquiries of various roads as to what they were using, and what they would recommend. We have received 17 replies to our inquiries. Out of this number 13 expressed themselves as being in favor of what is known as the Fletcher lid, three were in favor of the Hewitt lid, and one in favor of the drop lid. All were in favor of one size lid for any capacity of car. We would, therefore, recommend that one size of what is known as the Fletcher journal box lid be adopted as a standard, and that the executive committee be authorized to prepare standard drawing for the same.

J. W. Marden,
W. McWood,
L. Packard,
Committee.

After a short discussion it was decided to send the recommendations of this committee to letter ballot.

JOURNAL LUBRICATION.

Next report read was that on "journal lubrication and best practice for economizing oils." The committee held that great necessity exists for improving present methods. What is urgently wanted is a box so constructed that it will keep in the oil and exclude dust. The importance of this requirement is shown in the successful running of a watch for two or three years with one oiling, a result which is due to the perfect manner in which its moving parts are protected from dust and air. Held that the desire to maintain standards had militated against the introduction of an oil-box that would more nearly meet proper requirements of lubrication than the box generally in use. The gain of uniformity that followed the adoption of the standard oil-box led to loss so far as economy of lubrication was concerned. Recommended that the standard box be changed to some form that will allow inventors better facilities for producing a dust-tight housing. Mentioned the case of a dust-tight box in which a journal had run 100,000 miles on a sandy road with less than $\frac{1}{64}$ wear, and was oiled at intervals of six months. Concluded that the slightly increased cost of such equipment was a small item compared with the saving made in oil and wearing parts. The report was signed by H. Roberts and J. N. Lander.

Mr. Rhodes said that the wear of the journal was largely affected by its size, and asked for the dimensions of the journal referred to in the report.

Mr. Lander answered that it was 4 × 8 inches, and gave some particulars about the box.

This closed the business of the first day.

With the exception of some routine business, the greater part of the second day was devoted to the revision of the rules of interchange of cars.

TO PROMOTE THE SAFETY OF TRAINMEN.

At noon a motion was adopted to permit Mr. S. Coffin, ex-railroad commissioner of Iowa, to address the meeting. That gentleman then delivered a long and somewhat hysterical address on the subject of safety appliances for trainmen. He urged the members of the M. C. B. Association to use their efforts to have safety appliances, more especially the vertical plane draw-bar, put on cars. If railroad managers delayed much more in applying safety devices to cars, he favored the demand being made that the general government establish an inspection bureau to examine cars with a view to protecting trainmen in the same way that national inspection officers now look after ships to secure the safety of sailors.

On the morning of the third day the discussion of the rules of interchange of cars was finished and then the report was read of the committee on

CAR HEATING AND LIGHTING.

This report, which was very incomplete, gave a summary of replies to circulars showing that on the roads heard from 725 locomotives and 1,572 passenger cars had been equipped with steam-heating appliances, and that twelve different systems were in operation. The report concludes:

As stated in our report of last year, the unusual difficulties connected with the details of this subject have prevented any very rapid progress. The question of heating long trains is one of especial difficulty, and seems to be the severest test on most heating systems.

It will be noticed that some of the roads have developed systems of their own that have given satisfactory results, which is evidently possible when we consider the many ways in which the details involved in continuous car heating may be worked out.

The radiating system and pipe distribution inside the car will vary with the different methods of construction of the rolling stock, and must be adapted to suit the requirements so presented, always keeping in mind the features of sufficient radiating surface and a proper drainage of the piping. The exposure of the piping to continuous shaking and jolting requires an arrangement that will give the least number of small and light joints, as otherwise, after the cars have been in service but a few years, cost and annoyance from leakage would detract from the efficiency of this method of heating. The matter of drainage, previously mentioned, is one of the most important features in the arrangement of the pipes inside of the car, so as to prevent serious trouble from freezing and stoppage of circulation.

The method of the disposition of the condensed steam is one of the most difficult points connected with the subject of heating passenger cars by steam, and it is only by the results of actual tests that we are able to judge of what may be expected of any of the means that have been suggested and tried. It would seem that much difficulty was experienced at first with many of the steam traps that were used, and it was only by perseverance that an appliance was obtained that would fairly well automatically relieve the water and properly close at the beginning of the flow of steam. Your committee will again call attention to the matter of the effect of the discharge of steam upon the varnish and paint of the cars, and to the more or less objectionable feature of having water dropping about the stations and platforms.

The advisability of providing for emergency cases by allowing one or more stoves to remain in the cars is apparently foreseen, and it is proper to expect more or less occasional failures with continuous heating until the subject shall reach a generally satisfactory practical solution.

Some are giving attention to improving the heretofore very bad ventilation of passenger coaches, which your committee thinks should be taken up with the question of heating. The methods of accomplishing this result are dependent much upon the nature of the features involved in construction of the heating systems used.

Turning now to the arrangement under the cars, we find a condition of affairs that will require considerable investigation before any satisfactory results will be obtained. We refer to the question of uniformity of couplers. There are roads using a single, some a double run, and others have attempted a combination of two runs of pipe in one coupling. The double run of train pipe belongs principally to the so-called return systems, and the advantages to be derived, including economy, a proper disposition of the condensed steam, low pressure, and ease in heating long trains, we think are points which should allow the return systems serious consideration. The two runs allow also a straight pipe throughout the length of the car, thus avoiding the objec-

tionable bends, with their resistance, which accompanies the single train pipe. With the two lines of pipe, however, it is necessary to only dip them sufficiently from the center toward each end of the car, or from the ends to the center, to drain off all the water that may tend to collect, while the line is otherwise a straight one, and gives much less resistance to the flow of the steam, besides better facilitating the application of the pipes to the cars than where the single run is used In this case, using two couplers, it is not necessary that the two parts should be the same, nor that more than two flexible connections should be used in each car. Also the secret of long train heating is dependent upon the resistance which the main pipe offers to the flow of the steam, which is much influenced by the proper disposal of the water as soon as formed, and avoiding the collection in pockets or at places other than the outlets. Where the single line of pipe is used, it is necessary to pass under the car coupler when making the steam connection, which forms an abrupt pocket of some 8 inches between every two cars, while with the double run of pipe all this can readily be avoided. The other conditions which a good coupler should fulfill are a straight opening when coupled, automatically uncouple when cars are parted, interchangeability, ease of coupling, and while simple and inexpensive to construct, it should be reliable and steam tight.

As your committee was appointed with special reference to a coupler for steam pipes between cars, which might be submitted for adoption as standard by letter ballot, this question has been given the most careful consideration, but from the preceding details it may readily be understood that the committee does not feel prepared to recommend any of the existing devices for a standard of the Association, in coupling these pipes, for we believe that the interests of steam heating generally will be better served by awaiting a further development.

Having formed this view of the case, your committee addressed a special inquiry to officers of the Pullman Palace Car Company and the Wagner Sleeping Car Company, as parties representing cars most affected by lack of a standard in this respect, and both replied that they are not entirely satisfied with any of the devices yet brought to their attention. As neither of these companies is prepared to recommend any standard, and as there is not any great interchange of passenger equipment cars outside of the sleeping and parlor cars, your committee recommends that the matter of standard coupler for steam pipes between cars be left open for another year, when it is hoped that additional experience will aid in a wise selection, and especially as the absence of such a standard need not materially hinder the application of steam-heating appliances to 90 per cent., at least, of all passenger equipment cars.

F. L. SHEPPARD,
R D. WADE,
ROBT. MILLER,
Committee.

The report was received and the committee continued.

Mr. Robert Miller, Michigan Central, explained that the floods had prevented the committee from meeting, and that in consequence the report was imperfect.

Mr. Marden called for a free discussion of the report, as railroad companies were waiting for the action of the Association in the matter of car heating.

Mr. John Kirby, Lake Shore & Michigan Southern, stated that his experience with the Martin system led him to believe that too much piping was used. His company will likely reduce that for the trains next winter, and with that change and a better coupler he thinks the heating of cars with steam will be perfectly satisfactory.

Mr. Adams said that the Boston & Albany had had the greater part of the passenger rolling stock fitted with the Martin system for two years. Found fault with the slip joint coupler, but thinks the ball joint coupler will be satisfactory. They intended taking out all the spurs under the seats.

Mr. Kirby blamed the carelessness of trainmen for causing overheating of cars. A strong pressure was necessary at first to warm up cold cars, and the trainmen habitually neglected to reduce the pressure when part of the steam ought to be turned off.

Mr. Robert Miller had found it very difficult to regulate the pressure throughout the train. With an initial pressure of 30 pounds on the engines, the pressure in the train pipe would be reduced to nothing in the rear car, and, consequently, the front cars were overheated and those in the rear inadequately heated. The committee calls attention, therefore, to the return system as a possible solution of this difficulty. Mr. Bissell also stated that they had found difficulty in keeping steam-heated cars cool enough.

Mr. A. Dolbeer, Buffalo, Rochester & Pittsburgh, had found it impossible to restrict sufficiently the supply of steam through the system, and had concluded that too much radiating surface was used. He had found also that the slip joint is not practicable, and is not sure that the ball joint will be better.

Mr. Miller had condemned the slip joint from the start, and is apprehensive that the ball joint will leak after wear.

Mr. Barr said that more radiating surface is required in the district his road traverses than is necessary on many lines. His company are trying a regulating device to automatically shut off steam when the temperature of the car gets up to 70, and he thinks that something of the sort must be used. He explained the ventilating device in use by his company, which is found to work well. Our readers will probably remember that this device consists in a radiating coil placed in a box at one end of the car over which the air is passed as it comes in from a hood above the roof They have found that in the severe climate of the Northwest the train pipe carried under the cars is sure to freeze up, and have adopted an overhead train pipe, which they will, undoubtedly, continue to use. With this system the water of condensation is disposed of by natural drainage. When asked his experience with sleeping cars on the rear of trains, he stated that they had had very satisfactory results in heating their sleeping cars. They used the old Baker heater.

Mr. Casanave considered that steam heating was yet in its infancy; that we have not yet data sufficient for coming to any definite conclusion as between different systems, and therefore urged that the committee be continued without further discussion.

Mr. Marden insisted that the subject was of so much public importance that the discussion ought to continue.

Mr. Blackall had succeeded in heating the cars with steam without a single failure last winter, although the thermometer was at times 36 degrees below zero.

Mr. E. W. Grieves, Baltimore & Ohio, mentioned that a Maryland law making steam heating compulsory would soon take effect, and consequently they were deeply interested in the subject. They have now 75 cars equipped with steam-heating appliances, and have gained considerable valuable experience. He considered the subject of a coupler of supreme importance. They can heat the cars readily enough, and find no difficulty in regulating the temperature.

Mr. Schroyer had experimented a good deal with different methods of car heating, but had not found anything entirely satisfactory. The difficulties found had been unequal heating of the trains and of individual cars, freezing of traps and valves, and failure of the men to understand and properly work the various details of the system. In fact, while they had had no trouble in sufficiently heating a car, they had had a great deal of trouble with details. So far as the trap goes, he had found the best results from one which retained the water of condensation and does not let it bleed out.

After a little more discussion, it was decided to continue the subject and discharge the committee.

Next business taken up was the report of the committee as follows on

SPECIFICATIONS OF CAST-IRON WHEELS.

1. The chills in which the wheels of any one wheelmaker are cast shall be of equal diameters, and the same chill must not vary at different points more than $\frac{1}{16}$ inch in diameter.

2. Wheels of the same nominal diameter furnished by any one wheelmaker must not vary more than $\frac{1}{4}$ inch above or below the mean size measured on the circumference, and the same wheel must not vary more than $\frac{1}{16}$ inch in diameter. The body of the wheel must be smooth and free from slag, shrinkage or blow-holes. The tread must be free from deep and irregular wrinkles, slag, chill cracks and sweat or beads in throat, which are $\frac{1}{8}$ inch or over in diameter, or which occur in clusters of more than 6 inches in length.

3. The wheels broken must show clean gray iron in the plates; the depth of pure white iron must not exceed $\frac{7}{8}$ inches or less than $\frac{5}{8}$ inches in the middle of the tread, and shall not be less than $\frac{1}{16}$ inches in the throat. The depth of the white iron shall not vary more than $\frac{1}{4}$ inch around the tread on the rail line in the same wheel.

4. For each hundred wheels which pass inspection and are ready for shipment, one representative wheel shall be taken at random and subjected to the following test:

The wheel shall be placed flange downward on an anvil block weighing not less than 1,700 pounds set on rubble masonry at least two feet deep, and having three supports not more than 5 inches wide for the wheel to rest upon. It shall be struck centrally on the hub by a weight of 140 pounds falling from a height of 12 feet. Should this wheel stand 5 blows without breaking into two or more pieces, the hundred wheels shall be accepted.

The above test shall apply to standard weight wheels from 26 to 42 inches in diameter used on the standard gauge roads.

Or, the wheel shall be placed flange downward on a cast-iron ring weighing 1,000 pounds, the outside diameter of the ring being 36½ inches, the inside diameter 24 inches and thickness 8 inches, supported on rubble masonry at least 2 feet deep. It shall be struck on the plate, close to the rim, by a weight of 100 pounds falling from a height of 7 feet. When subjected to this test a 550-pound wheel shall stand 20 blows; a 575-pound wheel, 25 blows, and a 600-pound wheel 30 blows, without breaking a piece out. This test applies to 33-inch wheels; 26, 28 and 30 inch wheels must stand the 25-blow test, and the 36 and 42-inch wheels must stand the 30-blow test.

5. Should in either case the test wheel break in two or more pieces with less than the required number of blows, then a second wheel shall be taken from the same lot and similarly tested. If the second wheel stands the test, it shall be optional with the inspector whether he shall test a third wheel or not. If he does not so elect, or if he does and the third wheel stands the test, the hundred wheels shall be accepted.

6. Wheels shall not vary from the specified weight more than two per cent.

7. The flange shall not vary in the same wheel more than $\frac{3}{32}$ inch from its mean thickness.

8. All wheels shall be numbered consecutively, and shall have the number, also the day, month and year when made, plainly formed on the inside plate in casting, and no two wheels shall have the same numbers.

GUARANTEE.

THIS INDENTURE, made this.....day of..... .....18.... and between.....party of the first part, and.....party of the second part, witnesseth:

The party of the first part hereby agrees to furnish to the party of the second part, free on board cars at.....
.....chilled cast-iron wheels.....inches in diameter for use under.....

2. The party of the second part hereby agrees to pay to the party of the first part —— dollars for each wheel furnished, and to keep an accurate record of the mileage made by the wheels placed in service under cars in passenger equipment and under locomotives and tenders, and an accurate record of the number of months of service of the wheels placed in service under cars in freight equipment.

3. The party of the second part hereby agrees that when any wheel furnished under the contract is scrapped, to furnish to the party of the first part a statement which will show:

1. The wheel number.
2. The service in which the wheel ran.
3. The amount of service in months or miles.
4. The cause of failure.

5. A charge against the party of the first part of 55 per cent. of the price of the wheel mentioned above.

6. A credit to the party of the first part of

..... cents per 1,000 miles for 36, passenger equipment.
..... " " 33, " "
..... " " 30, " "
..... " " 36, locomotive and tender equipment.
..... " " 33, " " "
..... " " 30, " " "
..... " " 28, " " "
..... cents per month for 36, freight equipment.
..... " " 33, " "
..... " " 30, " "

Except in case of wheels removed for the following causes:

1. Flat by sliding.
2. Chipped flange.
3. Broken flange; if the breakage is not caused by seams, worn through chill, or worn flange.
4. Broken or chipped rim, not caused by rim being hollow.
5. Breakage of any kind caused by wreck or derailment.

4. The party of the first part hereby agrees on presentation of the statement above mentioned to pay the party of the second part any balance due from lack of sufficient service on the part of the wheels (with above exceptions) to balance the charge, and the party of the second part hereby agrees to pay to the party of the first part any balance due as shown by the aforesaid statement, settlements to be made quarterly.

5. The party of the second part hereby agrees to hold subject to the inspection of the party of the first part, for a period of 30 days after said statement has been rendered, any wheels (with above exceptions) which have not earned for themselves a credit equal to the amount charged against them.

6. It is understood that the basis of settlement shall be as follows:

26-in. passenger wheels	70,000 miles.
33-in. " "	60,000 "
36-in. engine and tender wheels	60,000 "
33-in. " " "	50,000 "
30-in. " " "	45,000 "
28 and 26-in. engine and tender wheels	40,000 "
Refrigerator, through line and cattle cars	24 months.
All other freight cars	48 "

Your committee has made some modifications in the specifications presented at the last meeting.

The third clause of Article 4 has been made more definite as to the number of blows required for the different weights of 33-inch wheels.

Article 8, which specified that the plates of a 550 to 575-pound wheel should not be less than $\frac{5}{8}$ inch in thickness, and that the plates of a 575 to 600-pound wheel should not be less than $\frac{3}{4}$ inch in thickness, has been omitted, as your committee is of the opinion that the weight of a wheel and the test to which it is subjected amply provides for the required thickness of the plates.

The proviso that the maker should not be responsible for wheels removed for sharp flanges, as specified in the sixth clause of Article 3 of the guarantee, has been omitted.

It has also been thought expedient to omit the sentence in Article 4 of the guarantee, which reads as follows: "It is, however, understood and agreed that no credit shall be allowed for excess of mileage for time service on freight wheels beyond the time guaranteed," as this entirely defeats the purposes of the guarantee.

The special purposes of this guarantee are:

1. To furnish railway companies wheel service at so many cents per 1,000 miles, or so many cents per month's service, so that they may know exactly what their wheel service is costing them.

2. To encourage wheelmakers to make every endeavor to furnish a safe and durable wheel. A guarantee of four years under freight cars means a guarantee of about 50,000 miles. If a wheelmaker gives this guarantee on freight wheels, a wheel of quite medium durability will meet the requirements of the guarantee. The guarantee for the passenger car and the engine equipment is much more severe, but as the maker furnishes about five wheels for freight equipment to one wheel for passenger and engine equipment, he can afford to take chances with an inferior wheel, as he makes his profit on five wheels in freight service, while he runs the risk of losing on one wheel in passenger service.

Again, it is a much more important matter to a railway company to increase the service of its freight car wheels from four years to six years or eight years than to increase the service of its passenger car wheels from 50,000 to 80,000 miles.

For these reasons it is thought that it is much to the advantage of railway companies to offer to wheelmakers a substantial inducement to make the most durable wheel possible and to share with the maker the profit arising from the same, and this is accomplished by the guarantee proposed, as is shown in the accompanying table.

This table is calculated as follows: If a wheelmaker agrees to furnish wheels at $10 apiece, and to settle on a credit of 10c. per 1,000 miles, the cost of the mileage will figure out as follows:

Cost of wheel	$10.00
55 per cent. of price	5.50
Cost to user	4.50
40,000 miles at 10c. per 1,000 miles	4.00
Total cost to user	8.50
Cost per 1,000 miles	.2125

This table is made out for wheels costing $10, $9 and $8 respectively, and for a mileage credit of 10c. to 6c. per 1,000 miles.

The figures given are comparative, showing the rate of decrease in cost per 1,000 miles as mileage results increase, but do not represent the actual cost to the user, as he has a credit equal to the selling price of scrap wheels.

With reference to the time guaranteed for freight cars, the ordinary freight car makes about 1,000 miles per month, so that if the word "month" is substituted for the term "one thousand miles" in the table, the cost per month is given.

With these remarks the specifications and guarantee are submitted with the belief that they are fair to both wheel user and wheelmaker; that these provisions will have a tendency to secure a safe and reliable wheel, and to induce makers to pay close attention to the question of durability, and in this way reduce the actual cost of mileage to the consumer.

Selling price of wheel.	Credit to maker per 1,000 miles.	Cost in cents per 1,000 miles to user if wheel makes a mileage of				
		40,000	50,000	60,000	70,000	80,000
$10	10 cents.	21.25	19.	17.50	16.43	15.62
	9 "	20.25	18.	16.50	15.43	14.62
	8 "	19.25	17.	15.50	14.43	13.62
	7 "	18.25	16.	14.50	13.43	12.62
	6 "	17.25	15.	13.50	12.43	11.62
$9	10 cents.	20.125	18.10	16.75	15.79	15.06
	9 "	19.125	17.10	15.75	14.79	14.06
	8 "	18.125	16.10	14.75	13.79	13.06
	7 "	17.125	15.10	13.75	12.79	12 06
	6 "	16.125	14.10	12.75	11.79	11.06
$8	10 cents.	19.	17.20	16.	15.14	14.50
	9 "	18.	16.20	15.	14.14	13.50
	8 "	17.	15.20	14.	13.14	12.50
	7 "	16.	14.20	13.	12 14	11.50
	6 "	15.	13.20	12.	11.14	10.50

J. N. BARR,
JOHN KIRBY,
GEO. F. WILSON,
} Committee.

The recommendations of this report were sent to letter ballot.

Next subject taken up was the report of the committee on a

STANDARD AXLE FOR CARS OF 60,000 POUNDS CAPACITY.

The committee submitting this report consisted of G. W. Rhodes, John S. Lentz and Robert McKenna. The report briefly outlined what had been done towards establishing a standard axle for a 60,000 pounds car, and the majority of the committee recommend an axle of the following dimensions:

Diameters.

1.	Diameter of journal	4¼ in.
2.	" wheel fit	5⅜ "
3.	" center of axle	4⅝ "
4.	" collar	5¼ "
5.	" dust-guard seat	5¼ "

Lengths.

6.	Length of journal	8 in.
7.	" wheel seat	7¼ "
*8.	" dust-guard seat	2 "
9.	" collar	⅝ "
*10.	" center to center of journals	6 ft. 3 "
*11.	" over all	7 " ¼ "

Mr. McKenna recommended an axle 7 feet 2 inches long and 6 feet 4¾ inches between centers of journals.

After the reading of the report the dimensions were, at the suggestion of Mr. Rhodes, taken up item by item and discussed.

Mr. McKenna insisted that the M. C. B. dimension of 6 feet 3 inches between centers of journal did not give sufficient room for the dust guard.

Mr. Schroyer favored the dimensions of an axle that retained the distance between centers of the standard axle, but he feared that such an axle would be defeated in letter ballot, and he thought it desirable to submit two axles to letter ballot.

Mr. M. M. Martin, Wabash, stated that his company had built many cars of 30 tons capacity, and the axle used was 6 feet 4¾ inches between centers, and journals 4×8 inches. He was anxious to see a standard axle adopted for heavy cars, but desired that the above dimensions would be decided upon.

Mr. Wall favored the sending to letter ballot of the two axles recommended by the majority and the minority of the committee.

Mentioned that the Pennsylvania Railroad has 10,000 cars with the length of axle recommended by the minority of the committee. His company would change their diameters to conform to this standard, and he thought that others ought to meet them half way by accepting their length.

Mr. Barr favored 6 feet 3 inches as the length between centers. Although a considerable number of cars have got the long axle, the cost of changing to a shorter one would be trifling to the expense of changing the housings of the great number of cars that will in the future be provided with a heavy axle.

Mr. Wall believed that the change of shortening the axle could not be made without changing the trucks.

Mr. R. D. Wade, Richmond & Danville, said that they had been putting in axles with the short distance between centers and found no difficulty in getting room for dust guard and sufficient hub clearance.

Mr. Robert Miller expressed preference for the short axle. Believed it a decided advantage to reduce the leverage.

Mr. Marden also favored the short axle, and held that the mistake of the existing standard was its being too small in the center.

Mr. Wall announced that the Pennsylvania company would not vote against a proposed standard axle because it was different from what they were using.

After some more discussion it was decided to send the axle recommended by the majority of the committee to letter ballot.

Next business was reading of the report of the committee on

STANDARD BRAKE GEAR FOR AIR-BRAKE CARS, WITH BRAKE SHOE FOR IRON BEAM.

In the study of this problem, your committee has had constantly in view the necessity of providing an efficient foundation brake, in order that the railroads may realize to the greatest extent the advantages of the large investments they are now making in air brakes. A brake gear that for many years may have given good results when operated by hand is found inefficient when actuated by air, and any attempt to perpetuate such a gear nullifies the advantage gained by the introduction of air power. There are to-day many cars running in this country where the air-brake mechanism has simply been coupled to the old style foundation brakes, with the result that the gear is constantly out of order, and the advantages expected from the use of air only partially realized. If trains are to be efficiently controlled, we must attach the air mechanism to a thoroughly reliable and mechanically designed system of foundation brakes.

It may at first appear that some of the recommendations of the committee are very radical, and that they involve a greater expense than is necessary; but your committee is prepared to stand on the proposition that it is useless for any road to adopt air as a braking power unless suitable and effective gear is provided to operate in connection with it. We have not made one single recommendation without careful study and experiment, and the question of expense has received constant consideration. The problems involved will be taken up in their natural sequence.

Brake Power.—With the application of the air brake to freight cars it is important, on account of interchange, that all cars should be uniformly braked in proportion to their weight. In the absence of any practicable device for regulating automatically the brake power on a car in proportion to the load carried and the speed at which it may move, the maximum theoretical power which can be applied is equal to the light weight of a car on the rails, assuming the common practice that the co-efficient of friction between brake shoes and wheels is the same as that between wheels and rails. Owing, however, to different conditions of rail and reasonable variations of air pressure, experience has shown that it is advisable to use a power somewhat less than this, and that 70 per cent. of the light weight gives the most satisfactory results and insures against liability of sliding wheels. This braking power should be generated from a train pipe pressure of 70 lbs. per square inch.

The value of a uniform train pipe pressure, and of having all cars braked proportionally the same, may be seen in the case of two roads interchanging cars, the one carrying a train pipe pressure of 60 pounds and applying a brake power of 80 or 90 per cent. of the light weight, and the other carrying a train pipe pressure of 80 pounds and applying a brake power of 70 per cent. of the light weight. Cars of the former running over the lines of the latter would have an excessive brake power with the latter's pressure, and the liability of sliding wheels would be very great, whereas cars of the latter running over lines of the former would not have sufficient brake power, and the value of the brake would, therefore, be partially lost. The importance of controlling the air pressure uniformly to the figure above mentioned cannot be overestimated. If it is allowed to go beyond this, the expense of wheels removed on account of flat sliding will undoubtedly be felt, and the value of the air brake impaired. Your committee, therefore, recommends that the leverage be proportioned to 70 per cent. of the light weight of the car and the maximum air pressure be 70 pounds to the square inch.

System of Levers.—As it is desirable that the arrangement of levers and rods in any brake gear should be as simple and have as few connections as possible, your committee has prepared plans, showing the best arrangement for each of the following conditions: Inside connected brakes with hand brakes at both ends. Outside connected brakes with hand brakes at both ends. Inside connected brakes with hand brakes at one end. Outside connected brakes with hand brakes at one end.

Brake Beams.—Your committee recommends the adoption of two brake beams, No. 1 to stand a load of 7,500 pounds, with a maximum deflection of $\frac{1}{16}$ inch, and No. 2 to stand a load of 15,000 pounds with a maximum deflection of $\frac{1}{16}$ inch. Beam No. 1 is intended for all freight cars now constructed and beam No. 2 for passenger and freight cars in the event of the adoption of a larger cylinder, or the introduction of a device for graduating automatically the braking power in proportion to loads and speed. Your committee advises against the use of a beam of any less capacity than No. 1, for the reason that any gain in first cost would be insignificant when compared with possible loss in security and multiplication of standards.

The very small deflection admissible is made requisite by the fact that the power generated in the brake cylinder of the air-brake is multiplied by means of levers in order to deliver the required brake power to the beams, and it is evident that any deflection or motion at the beam is multiplied at the cylinder to exactly the same extent as the cylinder power is multiplied at the beams; hence all unnecessary motion or deflection at brake beam must be eliminated. To illustrate: If a passenger coach required a brake power of 54,000 pounds delivered from a cylinder generating 4,700 pounds, there is a multiplication of the power by 11.4, and $\frac{1}{4}$ inch deflection at each of the four beams would give nearly 3 inches travel of the piston, which is a serious waste, detracting from the efficiency of the brake.

In order to demonstrate that the load of 7,500 pounds stipulated for beam No. 1 is correct, your committee would state that this is the limit of the stress with a reasonable margin of stock in shoes which the present Westinghouse freight brake mechanism is capable of exerting on the brake beam in every-day service.

A load of 15,000 pounds is stipulated for brake beam No. 2, because we already have passenger coaches weighing 60,000 pounds upon four wheel trucks, and if we allowed 90 per cent. as a brake power, a stress of 13,500 pounds would be exerted on each of the four beams. We now have passenger equipment cars weighing from 90,000 to 100,000 pounds on six-wheel trucks with brakes applied to all wheels where the brake beam pressure is from 14,000 to 15,000 pounds, and as it is also possible that a brake device may be brought out for graduating automatically brake power in proportion to the loads and speed, your committee considers it desirable that due allowance should be made for such requirements, and therefore stipulates the above load of 15,000 pounds.

The committee then give particulars of tests made with different brake beams. Details about brake shoes, the hanging of brake beams, etc., are given at great length. The report concludes:

Your committee would respectfully submit the following standards for adoption by letter ballot:

1st. That the maximum train pipe pressure be 70 pounds.

2d. That the brake power exerted on all freight cars be 70 per cent. of their light weight.

3d. That the arrangement of the brake gear for the four conditions named be as shown on sheet No. 3.

4th. That the details as shown on Sheet 2 be adopted, with all levers 1 inch in thickness. All pins be tuned to $1\frac{1}{8}$ inch in diameter, with 1.34 inch less. All jaws or clevises to be $\frac{3}{4}$ inches by $2\frac{1}{2}$ inches iron. All rods to be $\frac{3}{4}$ inches in diameter and all other details as recommended.

5th. That the position of train pipe cock and dummy coupling be as shown on sheet 1.

6th. That the brake beams for all present forms of freight cars be required to stand a stress of 7,500 pounds with a maximum deflection of $\frac{1}{16}$ inch, and where it is necessary to use a stronger beam that they stand a stress of 15,000 pounds, with a maximum deflection of $\frac{1}{16}$ inch. Where the Westinghouse beam is employed that the plan shown on sheet No. 4 be standard.

7. That where independent brakes and rubbers are used that the present Standard Christy or Collin rubber be maintained.

Your committee appreciates that the members of this Association are fully alive to the necessity of establishing uniformity in brake gear for freight cars, to the end that not only the greatest facility in making repairs to cars be secured, but also that the brake equipment on a car will be as useful on a foreign as on a home road. It is believed, therefore, that it is unnecessary to urge, by further argument, the adoption of the standards recommended.

Your committee is under special obligations to Messrs. Vogt, Bayley and Bush for the very complete and thorough tests made of brake beams and levers.

Respectfully submitted,
(Signed) Edward B. Wall.
Godfrey W. Rhodes.

This report was accepted and the recommendations of the committee sent to letter ballot.

The next business brought up was the

REPORT OF COMMITTEE ON "BUFFERS AND CARRIER IRONS FOR THE MASTER CAR-BUILDERS' TYPE OF COUPLER AND A STANDARD LENGTH OF DRAW-BARS."

When we were first served with notice of our appointment on the Committee for Buffers and Carrier Irons for the Master Car-Builders' Type of Coupler and a Standard Length of Bar, we considered that the subject was such that very little labor and investigation would be needed to make a report to this convention which would be satisfactory to ourselves and to you, and in which we could recommend for adoption those parts which would meet with general favor among the members, but we have found that the more study and thought we have given this subject, and the more extended our investigations, the more we are impressed with the importance of the subjects named.

We have had some considerable correspondence with parties having cushioned buffers, such as the Van Dorston, which is a direct buffer secured to the end sills or the deadwood block of the car, the construction of which is a cast pocket with cast buffer block fitted to the pocket and block of rubber set in bottom of pocket against which the buffer block rests. We have also been in communication with W. H. Bowman, of Rochester, N. Y., with reference to the Crouch air buffer, which is a cast-iron cylinder placed behind the draw-bar. It is not, however, sufficiently developed to warrant any recommendations from your committee at the present time. Your committee has also considered the Westinghouse buffer, which is attached to the draft rigging, and takes the blow through the draw-bar.

The difficulties we encounter in recommending a buffer for use with the M. C. B. type of coupler are, in fact, that we have been unable to discover any buffer except the Westinghouse and Crouch, which perform their functions when the knuckles of the bars are closed (as they invariably are in switching), and we believe that a large portion of the damage done to our draft rigging is while the switching is being done, in dropping cars down side tracks, and in cases of this kind the Van Dorston style of buffer is not operative at all, but the knuckle has then got to take the entire force of the blow. This would necessarily lead us to look in the direction of the Westinghouse or Crouch buffers for a device to be of practical service at all times, but your committee do not consider either of these devices sufficiently developed to warrant recommendations for adoption.

A great many of the roads now using the M. C. B. type of coupler are omitting dead wood castings entirely; some are using the single dead wood block, while others again are using the block with the dead wood castings bolted to the same, thus relieving draw-bar spring of the shock when coming together in making a coupling, but it does not relieve the draft rigging of any blow when the shock is taken with the knuckles closed; hence we refrain from making any recommendation in this direction until something more practicable has been devised.

The question of carrier irons is one in which we have met considerable opposition even among ourselves as a committee. While we on the Northwestern road are using a carrier iron, in which the opening of the draft sill guards is $5\frac{1}{2}$ inches in width by 6 inches in height, which gives us $\frac{1}{2}$ inch side motion of the bar in width, and $\frac{3}{4}$ inch upward clearance in height, the size of the neck of our bar being 5 inches in width by $5\frac{1}{4}$ inches in height, and we have found this to be a very good size, having but little trouble where used with a single link bar of the old style, our experience with the M. C. B. type of bar has been so limited that we do not feel disposed to be arbitrary, or insist on the balance of the committee taking these sizes as the proper ones to recommend for a standard.

Mr. Grieves, of our committee, who has had some trouble with the standard bar as a result of the narrow neck (5 inches in width), allowing the bar to twist in the carrier irons when struck on the face of the knuckle by the old style bar, and he claims that with a bar with 13 inches as the width of the head and with the blow taken on the side through the knuckle, as it necessarily is with the M. C. B. type of bar, that the neck is too narrow to sustain the heavy weight of the head and prevent it from twisting in the carrier irons.

The following is an extract from copy of a letter written by Mr. Grieves to Mr. Wall and myself:

"Referring to the question of buffers, carrier irons and standard lengths of M. C. B. coupler on which we have been appointed in the committee of the M. C. B. Association, I have talked with our Supt. M. P., A. J. Cromwell, and would say we have become thoroughly convinced that the barrel or neck of the Janney coupler, which is 5 inches by 5 inches, as shown on accompanying blue print 6,001 (I refer to the part passing through the carrier iron), is not at all heavy enough. This has been thoroughly demonstrated in our experience with the use of Janney couplers on freight cars, and when we commenced to apply the American continuous draw-bar to our cars, we made this part of the draw-bar $5\frac{3}{4}$ inches by 6 inches, as shown on blue print 6,126, which we think strong enough. We think that in considering the length of draw-bar, the matter of strengthening up the barrel or neck of the Janney coupler should also be taken into consideration, as 5 inches in the horizontal measurement of the barrel, is not sufficient to balance the head on the automatic type of coupler and bear the immense strain it receives by concussion when in service. We would suggest this part of the coupler be thickened up and made not less than $5\frac{3}{4}$ inches, measuring across the barrel.

"The necessity for strengthening the Janney coupler on passenger cars has been clearly demonstrated. The barrel on the old style of passenger car coupler was 5 inches by 5 inches at the point where it passes through carrier iron, but on the new style of Janney coupler, which we have adopted for all passenger cars, it is $6\frac{3}{4}$ inches by 5 inches."

On receipt of this letter, a copy of the same was referred to the McConway & Torley Company, manufacturers of the Janney freight draw-bar. The following is an extract from their letter in reply to Mr. Wall on this subject.

"From the letter of Mr. Grieves, which you inclose, we see that he is inclined to think that the neck of the Janney coupler, both for freight and passenger cars, is structurally weak, and he urges as the proper remedy for this alleged weakness an increase in the dimensions of the neck from 5 inches by 5 inches to $5\frac{3}{4}$ inches by 6 inches. Mr. Grieves states that he bases his opinion upon unsatisfactory service rendered by the Janney couplers in use on the Baltimore & Ohio Railroad. You ask if we have received complaints of failure in this particular.

"We have given careful thought to Mr. Grieves' letter and to your question and beg to submit the following reply:

"While a theoretical comparison of strength of material and cross section must govern the shaping of an experimental model for a coupler, the practical results obtained from actual service form the only safe criterion for the development of that model. Such practical experience we claim to have had, in greater degree, probably, than any other makers of automatic couplers. We have now furnished over 40,000 Janney freight couplers to railroads representing between 40,000 and 50,000 miles of road. We have made changes in our model as experience suggested their utility, and have kept careful record of the breakages that came to our notice, and have endeavored to tabulate such breakages in a way that would give us an insight into their cause and enable us to apply the proper remedy.

"Up to about January, 1888, we did not have in service a very large proportion of freight couplers as strong as is the coupler we now designate as the 'model of '88.' That model was the resultant of a great deal of work and a very considerable amount of breakage in the couplers which had gone into service prior to and during 1887. Taking our experience and observation as basis, we designed the model of '88, and from the date on which it went into service we made arrangements with three of the largest users by which report of all breakages and the character of the same should be made to us. These companies have now in service 12,012 freight couplers, most of which went into service prior to the current year. Our purpose in having those reports made was to inform ourselves as to the current year. Our purpose in having these reports made was to inform ourselves as to the adequateness of the measures which we had taken to strengthen the coupler. Our investigations were made to cover the New York Central system, the Erie and the 'Bee Line,' and these roads were selected because just at this time they were all applying couplers rapidly and in large quantities, and the service would give a fair criterion for our judgment. The figures given hereafter refer to these 12,012 couplers only, and we allude only to the above-named railroads when we speak of 'test railroads.'

"We inclose a sketch showing four different types of breakage which may be supposed to support Mr. Grieves' theory of weakness in the neck of the coupler.

"Of breakage like that shown in Fig. A we have a single case out of 4,000 couplers in service on the railroad where this breakage occurred. Fig. B also represents an isolated case of such fracture of the couplers in service on the railroad where this breakage occurred. Together they represent a total of two couplers of the 12,012 couplers in service on the test roads. Figs. C and D represent respectively a loss of two and 13 couplers out of the total number in service on the test roads. While it is conceivable that some of the terrific shocks which the M. C. B. coupler is obliged to sustain when used, as at the present time in service with the link coupler, may break a coupler of the most perfect material, the fact is nevertheless true that in the cases of nearly all of the above mentioned couplers there was a directly traceable cause of breakage not in any way connected with the design or dimensions of the couplers. While breakages, as in Figure D, have not been large in the aggregate, still we have been led to seek out their cause and apply a remedy. Our first patterns had the barrels turned from a piece of wood squared to 5 × 5 inches, and the turning of a perfect cylinder made the barrel about an eighth of an inch smaller than the square neck, and gave a shoulder which we now think undesirable. This has been remedied, and the barrel now has a full diameter of 5 inches, thus meeting flush with the square neck. This greatly strengthens the connection between barrel and neck, and will, we believe, prevent breakages of the D type. An increase in external dimensions would have been the serious objection that all twenty odd thousand cars now equipped with automatic couplers would no longer be standard, nor could the proposed standard coupler be applied to them for repairs without changing the stirrup strap. An increase of metal without change of external dimensions we hold to be inadvisable, first, because experience shows the present thickness to be amply strong; and, secondly, because it would necessitate a reduction in the size of the head of the draft bolt to permit insertion, and thus decrease the bearing surface at the crucial point in the tail of the coupler. To incur these disadvantages to prevent a possible loss, .0014 per cent. of breakage seems Quixotic.

"As to the passenger coupler, it is true that we manufacture two styles of standard passenger couplers, the No. 1, with a 5 × 5 inches neck, and the No. 1 P, with a $6\frac{3}{4}$ × 5 inches neck. This increase in the width of the neck is in no sense due to the weakness of the 5 × 5 inches neck, but exists only in our Janney coupler for use with the combination Janney-Miller platform and coupler. In order to accommodate the lateral motion of the Miller hook, we are obliged to have a wide stirrup strap, and to prevent this lateral motion of the Janney coupler, when it is substituted for the Miller hook in the same stirrup strap, we have increased the width of the neck of the Janney coupler. The B. & O. R. R., for reasons of their own, have recently adopted the use of the combination Janney coupler No. 1 P in place of the standard Janney coupler No. 1, and doubtless find that it gives good service; but, as we have not the record on which they based their judgment and changed their standard, we cannot give an opinion as to the matter of policy.

"It occurs to us that Mr. Grieves may not be aware that there is a difference in the thickness of material in neck of passenger coupler as compared with the freight coupler upon his conception of the passenger coupler. The thickness of the passenger coupler is $\frac{1}{2}$ inch, while the freight coupler is $\frac{5}{8}$ inch, making their comparative strength as 16 to 25, or, in other words, the cross section of the freight coupler is 50 per cent. stronger than the cross section of the passenger coupler.

"Our experience up to this time prompts us to object to any change in the dimensions of the neck."

The opinion of the McConway-Torley Company must surely have very great weight on this subject, as they are more directly interested in the proper sizes of the bar at this point than probably any of us present here to-day, especially as they are willing to stake the reputation and success of their bar on the size of this neck.

While the subject matter of the committee is not to recommend the proper size of the neck of the bar, the carrier iron necessarily involves specifying something that fits to the same, and in view of the large number of bars which are now in service and the tests which have been made of the same by the McConway-Torley Company, we, as members of the committee, cannot see our way clear to recommend any other size than that in service at the present time.

With reference to the standard length of draw-bar, your committee, after a careful consideration of this subject, have decided to recommend two lengths of draw-bar, one of 30 inches, to be used on all new cars to be built in the future, and one of 28 inches, to be used where desired, but only in repairs of cars now in service. The establishment of this double standard will, it is believed, best meet the needs of the association.

Roads using the 28-inch bar and damaging a car with 30-inch bar to have the privilege of replacing the same with a 28 inch bar, using a 2-inch filling block at the rear end of the bar and increasing the length of pocket or tail, as the case may be. Cars on which 28-inch bar is used must have their couplers replaced with 28-inch bars.

In order that there may be absolute uniformity in the tail end of all M. C. B. couplers as they come from the foundry, your committee recommends the form shown on drawing . . . On

this drawing we also give the attachments by which this tail can be made to either receive the pocket or tail bolt.

It must be borne in mind that the important feature of the subject is the tail end of the coupler. The attachments are only given as guides or suggestions, as they may be varied to suit different requirements without interfering with the interchangeability of the coupler.

In conclusion, your committee respectfully submit for adoption by letter ballot the following standards:

1. That there be two lengths of draw bars, one 30 inches and one 28 inches, as shown on drawings ——; the first to be used on all new cars, the second when desired on cars now in service, in the manner explained in the body of the report.

2. That the neck of the draw-bar back of the head be five inches square

3. That the tail end of the coupler be as shown on drawing No. ——.

4. That the open space in the carrier iron measure 5½ inches horizontally and 5¾ inches vertically.

Respectfully submitted,

C. A. SCHROYER,
EDW'D B. WALL, } Committee.
E. W. GRIEVES,

Mr. Grieves, after the report was received, made a formal dissent from the second and fourth recommendations.

Mr. Mackenzie could see no necessity for a 28-inch bar, and considered it unsuitable for the standard coupler.

Mr. Schroyer objected to increasing the length of the draw-bar from 28 to 30 inches and could see no merit in the proposed change. Asserted that 30 inches was recommended simply because that was the length of the Janney draw-bars first used on the Pennsylvania.

Mr. Barr had no objection to a change to 30 inches, so long as he could use 28 inches in repairs and accepted in interchange of cars.

Mr. Wall proposed an amendment, which was adopted, to the first recommendation of the committee, by which it was agreed that the M. C. B. standard length for the draw-bars of all new cars shall be 30 inches, and that a draw-bar of 28 inches may be used in all old cars now in service.

On motion of Mr. Casanave, the convention voted to submit the five recommendations of the committee to letter ballot.

After some routine business was disposed of the committee, consisting of J. N. Barr and J. D. McIlwain, reported the following

SUBJECTS FOR NEXT YEAR'S REPORTS.

Standard axle box for 40,000 and 60,000 pound cars and best box lid.

Best metal for brake shoes.

Ventilation for steam-heated cars.

A system of joint car inspection.

Car seals; how may imperfections be best detected and reported?

The substitution of steel plates and malleable iron for cast iron in car construction, with a view to reducing weight.

Lighting cars in passenger trains.

The following committee was appointed to report, next year, subjects for 1891: E. Chamberlain, John MacKenzie, J. H. Rankin.

The auditing committee, consisting of Messrs. Barr, Chamberlain and MacKenzie, reported that the accounts of the secretary and treasurer were correct.

The Committee on Subjects suggested the following: Standard Journal Boxes for 40,000 and 60,000-lb. Cars; Best Metal for Brake Shoes; Ventilation of Steam Heated Cars; Joint Inspection: Uniform System of Inspection and Report of Car Seals; The Substitution of Steel Plates and Malleable Iron for Cast Iron in Car Construction, and the Lighting of Passenger Cars.

Charleston, S. C., was selected as the next place of meeting.

The election of officers resulted as follows, no opposing nomination having been made: President, William McWood; first vice-president, C. A. Schroyer; second vice-president, E. W. Grieves; third vice-president, J. S. Lentz; treasurer, John Kirby; executive committee, R. C. Blackall, Eugene Chamberlain, F. D. Casanave.

The convention then adjourned to meet in Charleston, June 12, 1890.

Demands More Care in Firing.

The following general order explains itself:

CHICAGO, ST. PAUL, MINNEAPOLIS & OMAHA RAILWAY CO.
GENERAL SUPERINTENDENT'S OFFICE,
ST. PAUL, Minn., June 24, 1889.

M. Ellis, M. M., St. Paul Shops:

DEAR SIR: 1. Situated at a long distance from coal-producing territory, the fuel consumed by locomotives has been so large a proportion of operating expenses of this road that it has become our duty to take vigorous measures to lessen amount consumed. Extravagant, irregular and careless firing will, however, defeat every effort we make toward economy in fuel.

2. It is a common practice for some firemen to throw a large amount of coal into furnace at one firing, thus making fire so deep that it cuts off air supply that should come through grates, and in consequence the coal on top is rapidly coked by heat underneath, and gas and smoke (the very cream of the coal) escape unconsumed. An equal amount of coal placed in furnace in three or four firings instead of one would in many instances evaporate much more water and almost entirely avoid the emission of black smoke from stack.

3. A matter of great importance is proper admission of air to furnace. Dampers should be regulated to govern this. When too much is admitted, temperature of fire-box is lowered, with consequent loss of steam, and when not enough air is admitted much of the coal becomes coked, caused by improper combustion in fire-box. Amount of air admitted should be in proportion to quantity of coal and steam used, and as this varies with load hauled, grade ascended, and speed, so also must supply of air and fuel vary, and enginemen should see that both are fed to furnace in a regular and careful manner, always proportionate to work done by locomotive.

4. Enginemen should see that coal is properly broken and wet down before firing, and that it is distributed equally over grate surface.

5. The frequent "blowing off" of locomotives caused by excess of steam is an indication of carelessness and waste of fuel, and denotes a reckless disposition of enginemen, so far as life and property are concerned. Frequent accidents are caused, and many large damage claims have been paid by this company on account of sudden and unexpected opening of escape valve, frightening people and horses; and as it is well understood that it can nearly always be avoided, we have determined that it shall now cease, especially at stations and in yards.

6. By strict attention to these suggestions, and due regard by enginemen to working of engines as economically as possible, always remembering that it takes money to produce steam, and should be dealt out with judicious care, advantage being taken of its expansive qualities, much coal that is now wasted would be saved. Another source from which much fuel expense obtains is the manner in which some enginemen admit feed water. They will put on injector or pump to its full capacity until boiler is filled, then shut it entirely off until it again requires filling. This practice causes great waste of fuel, and is destructive to boiler from its constant change of temperature. To get best results, feed water should be admitted as constant and even as steam is used, and should be graduated closely to that point.

7. It is but just to a large per cent. of our enginemen to here state that criticisms above set up do not apply to them, as in my frequent trips over the system I discover their engines properly handled, and in my careful examination of reports know they are interested in fuel economy and all other matters above referred to; but there is, unfortunately for us, a certain per cent. of the men to whom they forcibly apply, and I sincerely hope these will give the suggestions above noted their closest attention, and post themselves fully on all points governing economy of fuel, and I desire you to have a distinct understanding with our engineers and firemen that hereafter those who show best record for economy in dealing with the company's fuel and other supplies will be the men first selected for promotion, all other qualifications being equal. I believe we can run more miles per ton of coal than is now being done, and am confident we have a class of men who are capable of doing it if they only try, and the time has now come for their best exertions in that direction.

8. A very meritorious work, in small book form, has been recently issued on combustion in locomotive fire-boxes, by Angus Sinclair, of New York, and you may say to such enginemen as have not possessed themselves of, and would like to have it, that if they will hand in their names to you this company will subscribe for them at its own expense.

W. A. SCOTT, General Superintendent.

Subjects for Investigation by the Master Mechanics' Association.

The following circular has been sent out from the office of the Secretary of the American Railway Master Mechanics' Association, 140 Nassau street, New York:

NEW YORK, July 20, 1889.

Below is a list of the committees appointed by President Briggs to carry on the work of investigation and other business during the year. The name first mentioned is chairman of each committee. One associate member has been placed upon each committee, and it is expected that these will use their efforts to obtain scientific data and to furnish information that may be obtained outside of railroad sources. The chairmen of the various committees are urged to organize the work to be done by the different members and begin the investigations assigned to them as early as possible, that valuable reports may be prepared in good season for the next convention. The work of the XXII. convention was greatly facilitated by most of the reports being delivered early.

For the Executive Committee,
ANGUS SINCLAIR, Secretary.

COMMITTEES.

1. Exhaust pipes, nozzles and steam passages; best form and size in proportion to cylinders. Committee: C. F. Thomas, A. W. Gibbs, Ross Kells, John A. Hill.

2. Compound locomotives; their efficiency as compared with simple engines. Committee: J. Davis Barnett, John Player, H. D. Garrett, F. W. Dean.

3. Testing laboratories, chemical and mechanical. Committee: Philip Wallis, George Gibbs, G. W. West, D. L. Barnes.

4. Efficiency of the link, as compared with other valve motions. Committee: James M. Boon, David Clark, H. Tandy, John A. Coleman.

5. Advantages and disadvantages of placing the fire-box above the frames. Committee: Fred. B. Griffith, James Macbeth, W. A. Foster, L. F. Lyne.

6. Relative value of steel and iron axles. Committee: John Mackenzie, J. S. Graham, John S. Cook, Thomas Shaw.

7. Brick arches in locomotive fire-boxes. Committee: T. W. Gentry, Allen Cooke, L. C. Noble, W. A. Smith.

8. The best means and the economy of preserving locomotive tanks from corrosion. Committee: W. J. Robertson, Albert Griggs, O. Stewart, Jerome Wheelock.

9. Purification or softening of feed water. Committee: W. T. Small, Harvey Middleton, A. W. Quackenbush, John W. Hill.

10. The best form and size of axles for heavy tenders. Committee: W. Swanston, W. Garstang, James Maglenn, L. R. Pomroy.

11. The present status of the "automatic car coupler question," and whether this Association can endorse the action of the M. C. B. Association in recommending the vertical plane type as a standard, from a mechanical standpoint. Committee: John Hickey, G. W. Rhodes, Sanford Keeler, M. N. Forney.

Obituary.—GEORGE C. WATROUS. Committee: C. E. Smart, T. J. Hatswell, S. D. Bradley.

Obituary.—S. W. HAINES. Committee: L. H. Turner, Wm. Flahaven, E. Richardson.

They have a somewhat novel plan for removing old paint from locomotive tenders in the Susquehanna shops of the Erie Railroad. The usual practice is to burn the paint off with a hot blast vapor lamp, which is a slow and expensive method. Here they attach the tender hose to the heater pipes of the shop and blow steam into the tender, which soon makes the paint so soft that it can be scraped off with very little labor.

Effects of Steel on the Strength of Castings.

The following table gives the results of some experiments on the effects of the addition of Bessemer steel to car-wheel iron on the tensile strength of the resultant metal:

	Tensile strength per sq. in. of section. Pounds.	Percentage of steel.
No. 1.....	25,345	8 per cent. steel.
No. 2.....	20.708	Richmond iron.
No. 3.....	29,064	22 per cent steel.
No. 4.....	25,474	Richmond iron.
No. 5.....	27,930	Steel.
No. 6.....	21,922	Richmond iron.
No. 7.....	18,859	No. 1 Parrott anthracite and 50 per cent. steel.
No. 8.....	15,206	500 pounds steel, 636 hard Parrott 333 pounds soft Parrott.
No. 9.....	23,654	Anthracite iron and steel.
No. 10.....	17,137	Steel, anthracite iron and scrap in equal quantities.

It will be seen that the mixture of steel and iron is stronger up to a certain point than the iron alone, but tests Nos. 7, 8 and 9 would seem to indicate that after a certain percentage has been passed there is a falling off in the tensile strength of the metal.

These figures are chiefly interesting from the experiments of the Pennsylvania Railroad in the same direction. We believe, however, that they have discontinued the use of the crop ends of steel rails, and that they never did use more than five per cent. in their mixtures.

Railroad Extension this Year.

In the issue of July 12 the *Railway Age* publishes a statement giving the tracklaying for the first six months of this year, and the figures show that 1,522 miles of new track have been laid and that part of the work was done in 31 states. As the *Railway Age* has long made a specialty of recording every increase of railroad mileage, and the information collected in this department has been noted for its accuracy, the figures may be accepted as correct.

Commenting on the subject, the *Railway Age* says: "The 1,522 miles which have been added to our railway system in the past six months do not represent quite half the mileage reported for the same period in 1888, in which year the total of construction was about 7,100 miles. The number of lines, however, is not very much less, and on the other hand the number of roads on which track had been laid in the first half of 1888 was considerably larger than that in the same period in 1887, although the total mileage of 1887 was nearly twice that of the following year. These facts indicate what has been already referred to, that the tendency in the last two years has been to the construction of numerous short lines instead of a lesser number of long, competitive lines, and in confirmation of this we find that the average length of all the track reported laid in the first half of 1887 was 27 miles to each road, while in the same period of 1888 it was only 20 miles, and in the first six months of the present year it has averaged only 12.3 miles. This indicates a very healthy condition of growth, the railway building now not being done in mad haste in order to occupy new territory before a rival has got there, or because he has already got there, but the roads being built because they are believed to be needed. Very much of the work now going on is in the form of branches or extensions of old lines, but quite a number of roads are being built by independent companies.

It will be seen that the largest part of the tracklaying thus far this year has been done in the South, six of the Southern states reporting 611 miles, and ten of them showing 784 miles, or more than half of the entire mileage thus far recorded. This indicates the general activity of development in the South; although some allowance should be made for the fact that the climate there is more favorable for railway building in the first part of the year than is that of the Northern states. Mississippi shows the largest figures thus far, this, however, being due chiefly to the completion of the Georgia Pacific Railroad. During the next six months some of the Northern states will add considerable mileage, notably New York, Pennsylvania, Ohio, Michigan, Illinois, Minnesota and Washington, while almost every state and territory has enterprises under way from which some new track may be expected, and the Southern states will still continue prominent.

After careful experiments made on behalf of the Chicago, Burlington & Quincy Railroad, at Aurora, Ill., regarding the natural seasoning of various woods, it was concluded that oak began to season naturally in March or April; that pine lost moisture within a fortnight after its first exposure, that ash and poplar began the loss in April, and elm immediately on being exposed in January. With the exception of elm the seasoning of most woods ends with the summer months. All woods take up slight moisture during wet weather in fall and winter; pine of small dimension, like inch flooring, will absorb moisture during the wet months; one season of average weather is generally sufficient to season wood for purposes of construction.—*Lumberman.*

The New York, Lake Erie & Western have lately applied a Rushforth feed-water heater to one of their fast passenger hard coal burning locomotives. The mechanical officers and engineers say that the device has made a decided reduction in coal consumption, besides improving the steaming qualities of the engine.

Railway Car Construction.

BY WILLIAM VOSS.

Eleventh Paper.

SWING MOTION TRUCKS.

In this class of truck the bolster is arranged for a limited lateral motion in addition to the necessary vertical motion on the springs, and for the purpose already stated. The method of construction adopted to this end by the different builders is in all essential points the same; it consists in suspending the spring-plank from and between a pair of cross-beams or *transoms* by pivoted iron links or hangers in such manner that it is free to move in the direction indicated.

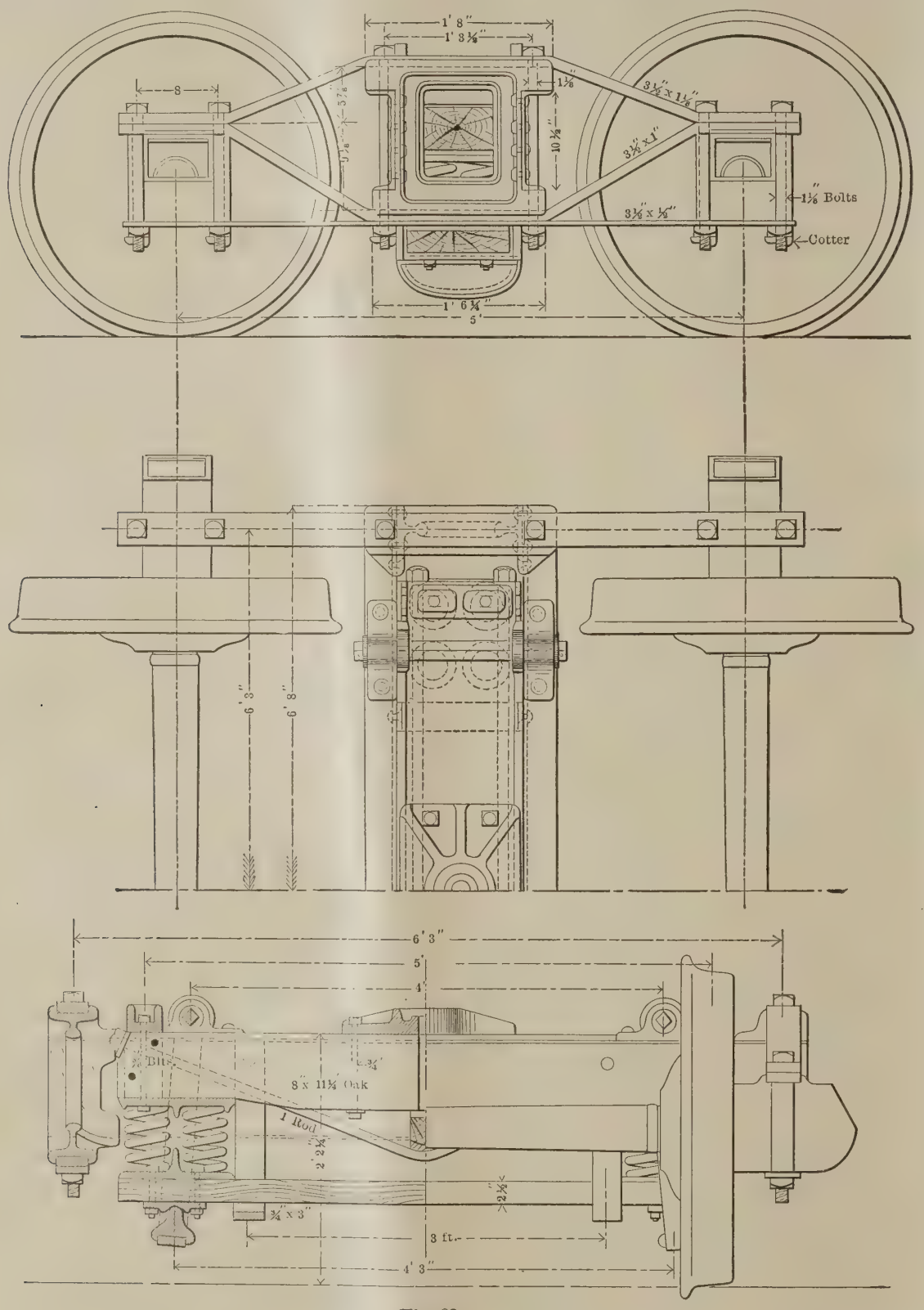


Fig. 82

The transoms, which are placed at a distance of from 12 to 14 inches from each other, together with the end castings, to which they are bolted in case they are of wood and riveted when they are of iron, take the place of the spring-plank and columns of the rigid truck. The manner of connecting the transoms with the side-frames is variously arranged, that shown in Fig. 82 being most frequently used, although some of the other forms are equally as good. In this case the transoms are steel channel bars, which, however, alters the dimensions only and not the general form of the castings. The channels are secured to these end-castings by a number of ⅝-inch rivets, the whole forming substantially one piece in the shape of an open box, to which the arch-bars are attached by four bolts passing through the castings and the flanges of the channel bars, the connection being further strengthened by flanges provided on the end-plates where these come in contact with the arch-bars.

Fig. 83 shows a construction much used in connection with wooden body-bolsters, which make it necessary to elevate the swing-beam, and, consequently, the truck-transoms, several inches higher than iron body-bolsters require it. The end-casting is shaped to meet this condition, but with this exception, and the larger proportions compelled by the transoms also being made of wood, is substantially the same as that in Fig. 82. Instead of the customary single column bolt, two are used in this instance, but the second bolt is of but little, if any, service for carrying the load, although it is a simple and effective safety hanger in case the first bolt accidentally breaks.

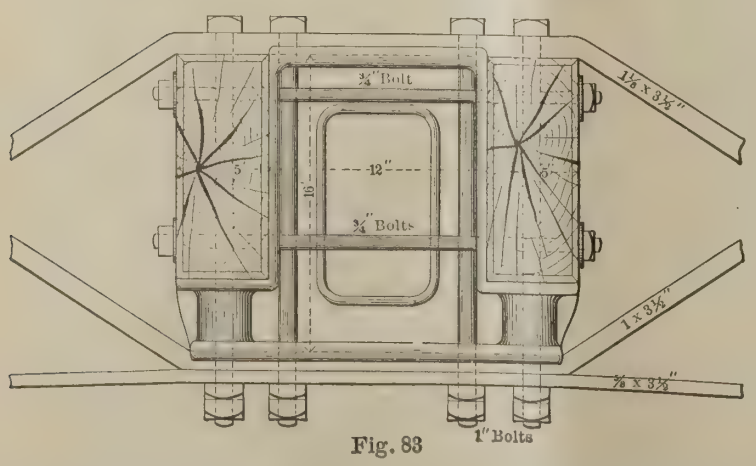


Fig. 83

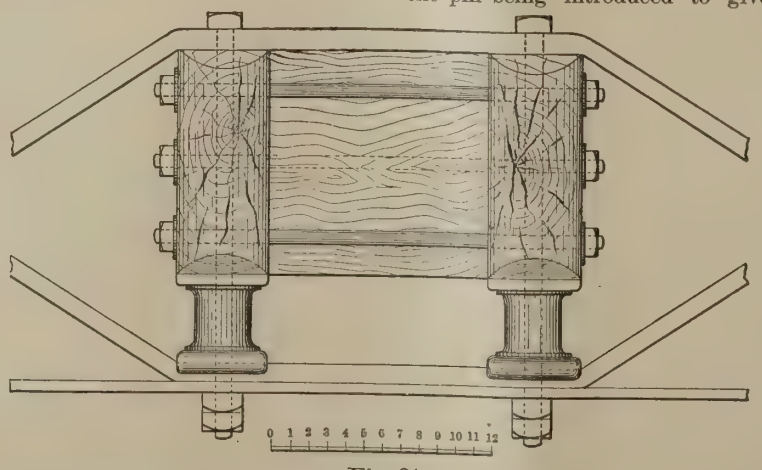


Fig. 84

In Fig. 84 the end-casting proper is done away with, a block of wood, framed to the transoms with mortise and tenon, being used to separate them, and light cast-iron posts to support them. The construction is cheap and simple, and would answer the purpose admirably if wood did not wear and shrink so much, and, as this is not always equal on both sides of the same truck, the chances are that the axles are thrown out of tram when the shrinkage of the timbers is compensated for by screwing on the bolts.

In Fig. 85 the vertical distance between the arch-bars is equal to the depth of the timbers—which is seldom more than 12 inches—and as this is too shallow for a truss sufficiently strong for the heavy loads now carried, a supplemental arch-bar is introduced below it. This somewhat complicates the construction without any apparent beneficial results. One truss composed of but two bars, and these of the proper form and dimensions, being preferable to two or more trusses supplementing each other, unless each of these are able to carry the load if the others happen to fail.

The spring-plank sustaining the springs and bolster is, as has been stated, suspended from the transoms, the most prominent arrangements used to effect this being treated in the following sketches.

Fig. 86 shows one of the earlier forms which has, however, been abandoned on account of the quick, jerky motion obtained with it, resulting from the shortness of the hanger and the liability of the hanger to fracture. The metal of which the eye-bolts and links are forged is from 1¼ to 1⅜ inches in diameter; the cross-pin on which the spring-plank rests is 1½ or 1⅝ inches and is provided with a head on one end and a split-key on the other to retain it. The plank does not directly rest on the pin; a suitable shaped casting fastened to it with small lag-screws is used as a seat for the pin, with the object of taking the wear caused by it, and also to increase the bearing surface on the plank.

The long link-hanger was the next step in the direction of improvement; it is forged of rectangular shaped bar-iron about 1 inch thick by 1¼ or 1½ inches in width, and is suspended from a pin, of about the same diameter as that in the preceding sketch, placed across the transoms and resting in cast-iron sockets secured to them. The arrangement at the lower end of the hanger remains the same.

Both hangers and pins being of wrought-iron, with the fibres of the one crossing those of the other, and the surfaces in contact being rather small, caused them to be rapidly worn and become dangerous, and more so as the location of the parts is such that they are difficult to inspect. A hanger which is much used, because it partially overcomes the above objections in that the wearing surfaces are somewhat increased, and also because it requires less cutting away of the swing-beam, is made of flat bar-iron thickened at the ends where the pin-holes are either drilled or hot-punched.

This hanger as commonly made has, however, the additional fault of liability to fracture; the thickened ends are produced by doubling the metal back on itself and then welding it, or by welding separate pieces on the face of it. In either case that portion of the metal immediately back of the weld, and which has of necessity been white hot, does not receive sufficient working to again produce a grain, and the fracture, if any, will occur at this point. A hanger drawn down from a thick bar is free from this defect as the iron does not require nearly as much heating; the slight advance in cost of manufacture if such exists, will be more than offset by the better article produced.

In Fig. 87 the ordinary link-hanger is much improved by the addition of cast-iron wearing-blocks. With them the hangers are not subjected to any wear, and that of the pins is materially reduced by the increased wearing surface and by the substitution of cast-iron for the cross-grain of wrought-iron. These wearing-blocks are semi-circular in shape at one end to conform to the curve of the hangers, the parallel sides extending far enough to prevent them from turning over. Usually the blocks are made long enough to entirely surround the pin, the extra metal below the pin being introduced to give the blocks sufficient strength. To keep the blocks in position, they are cast with flanges which can, however, extend but partially on one side in order to get them inserted. The side of the block having a complete flange is placed next to the transom when on the upper pin and next to the spring-plank when on the lower to guard against accidental displacement.

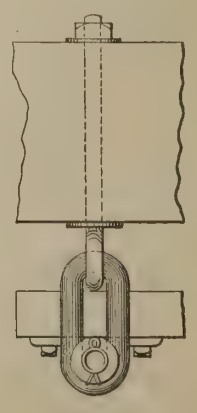


Fig. 86

In Fig. 88 the hanger is attached without the usual upper pin and the danger from the breaking of this does therefore not exist. The link-hanger, assuming a slightly altered form on the upper end, passes through a slot or mortise cut in the transom, which is enough increased in thickness to compensate for the portions cut away. The upper end of the hanger surrounds a casting shaped similar to the wearing-blocks described, which rests but is free to rock on a slotted casting surrounding the mortise in the timber to which it is secured with lag-screws.

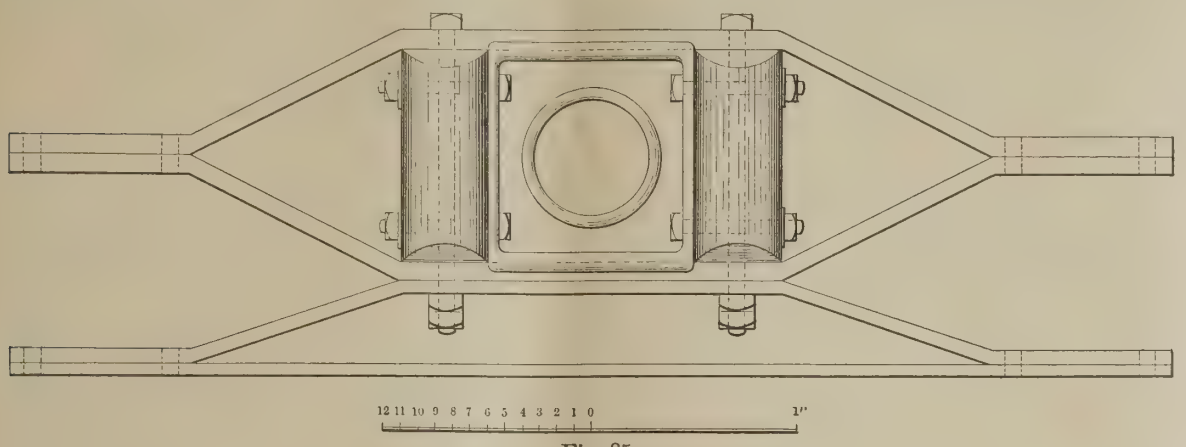


Fig. 85

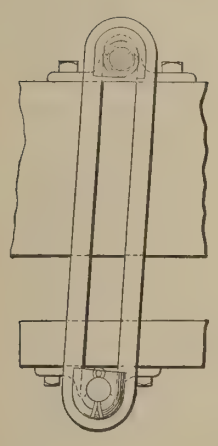


Fig. 87

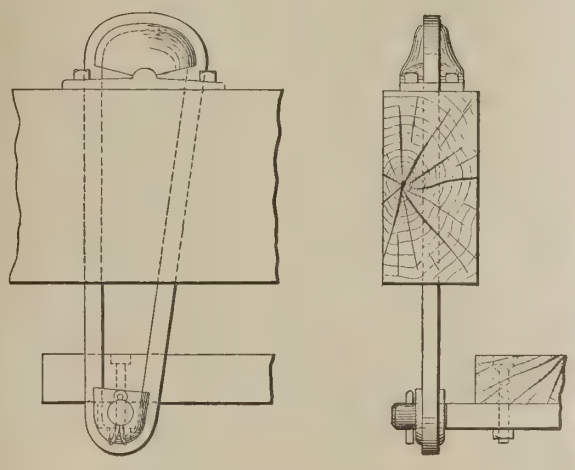


Fig. 88

The upper wearing-block in this case serving a somewhat different purpose requires to be of ampler proportions, and to make room for its increased width the opening at this end of the hanger is proportionately enlarged. To avoid great height above the transom and an excessive amount of material in the block and hanger, the tops of both are made straight, with the corners rounded or oval instead of circular, this shape being better adapted to prevent shifting of the block. Both upper and lower blocks can have full flanges on each side; the upper one is narrow enough to be inserted without any difficulty, and the lower can be entered at a point where the opening in the hanger is wide enough, and then be lowered into place.

In Fig. 82 the construction of the parts under consideration are so designed that practically no friction and consequently no injurious wear is possible. This is accomplished at the upper end of the hanger by employing a cross-pin with a square instead of the usual circular cross-section, which, by the likewise square openings in the hangers through which it passes, is compelled to move with the hanger. This square bar is applied in a diagonal position, so that one of its four corners only comes in contact with the sockets, whereby a rocking instead of a rubbing motion is produced. Instead of two separate hangers a U-shaped strap is used, which surrounds and supports a casting on whose narrow and rounded edge the spring-plank is pivoted. In order to bring every part of the hanger under tension and avoid all cross strains liable to result in fracture, it is given the curved shape shown.

The burden-springs, of the same patterns and dimensions as those used with rigid trucks, are attached to the spring-plank in a similar manner, but not at the same distance from each other. This distance is, however, made as great as the space between the truck end-castings will admit, and is equal to this, less three inches usually allowed for the motion of the swing-beam at each end. The distance between the hangers, at the point where they support the plank, is the same as that from center to center of the springs, but is from 2 to 3 inches less on the transoms, for the purpose of making it more safe while rounding curves at a high rate of speed. The action produced by this inclination of the hangers tends to raise the spring-plank at one end and lower it at the other, thereby forcing the top of the car in an opposite direction from that imparted it by the centrifugal force. A proper adjustment of the hangers in this direction—which is reached by locating the center of motion of the spring-plank, when in its normal position, as little above the center of gravity of the load as is consistent with stability—also facilitates the lateral movement of the wheels and axles independent of the car-body. With parallel hangers, the slightest motion to either side is opposed by the gravity of the car and load, which has to be raised bodily and in proportion to the distance moved sideways. The oblique hangers, as already mentioned, raise the swing-plank and beam on one end and lower it at the other, leaving the center approximately at the same level—that is, till the lowering hanger passes the perpendicular, when both ends of the plank, and, consequently, the center, also begin to ascend.

There seems to be, however, a divergence of opinion as to how much the lateral motion should be checked; that it must be checked at some point is essential if the body is to remain inside the right of way. Perhaps the freight-truck designer can learn and adopt from the passenger trucks, which are especially designed to produce an easy motion. These almost invariably have comparatively very short hangers, and in the best practice also have small coiled springs attached to the ends of the swing-beam to gradually check its end motion and to return it to its normal position

As an additional precaution against accidents from the failure of pins and hangers, every first-class truck now includes a pair of stationary safety hangers. These are U-shaped straps of about $\frac{5}{8} \times 2\frac{1}{2}$ inch iron extending from one transom to the other and passing under the spring-plank, clearing this about one-half of an inch so as not to hinder its motion. They are usually located inside of the swinging hangers, and as close to these as practicable. When the transoms are iron or steel, the straps are secured on the inner face of these by two $\frac{3}{4}$-inch rivets, and when of wood the straps terminate at the under side of the timber, where they are held by bolts as indicated in Fig. 87.

Ordinarily the swing-beam is of sufficient size to support the weight carried by it without the help of truss-rods, but in this instance it is so strengthened. The rods are applied in about the same manner as those of the rigid truck-bolster except that the timber is bored to receive them instead of having grooves at the sides; the limited space between the beam and transoms makes this necessary.

The swing-beam is guided in its movements by the transoms, but comes in contact with these only through what are termed rubbing-plates. Some years ago it was thought that these plates might be dispensed with, not so much as a point of economy but because as then applied they were troublesome to maintain. The experiment had to be abandoned, however, the timbers without some protection wearing very rapidly. The rubbing-plates are still mostly of cast-iron, but being made somewhat stronger and better fastened—bolts being used instead of nails or screws—are less liable to break or lose off than formerly. The proper place to apply the plates is as near the end of the beam and transoms as possible, especially when the truck has channel-bar transoms, these having proved too weak laterally when the plates are located as formerly, that is, between the hangers.

A Representative American Enamored with English Railroading.

Mr. F. F. Hemenway, editor of the *American Machinist*, went to Europe with the American engineers, and he has been writing very interesting letters to his paper about what he saw. Nearly all American travelers consider it the proper method to find fault with many phases of British railway practice, especially the way baggage is handled, and with the cars. Mr. Hemenway found that these things suited him very well. He says:

"I had read a great deal about the trouble of unchecked baggage, and expected, if the stories of travelers could be relied upon, a good deal of skirmishing and considerable delay in London. But about as soon as I struck the platform a porter was alongside. I told him how my baggage was marked and where I wanted to go; everything looked in a snarl around the luggage van, and I saw the porter merge himself in the crowd, with some misgivings as to when he would get out again. He soon emerged, however, triumphantly. I looked at my watch when the train stopped and again as the cab started; the time had been 15 seconds less than three minutes. An American baggage master, when you could have got to him, would have spent about that time in looking at you if you were trying to get your baggage in less than 15 minutes after the train arrived. I mention the exact time, as I took considerable pains to note time for a purpose. I had really believed that the American plan expedited getting along with baggage wonderfully, that it was more mechanical, methodical and all that. I have very serious doubts about it now—in fact, I do not believe it at all. The English system requires the services of more men, but everything is done quicker, and, it seems to me, better. Probably, as in many other things, each system is best in its place, but it don't help American railroading to tell stories about what is done elsewhere.

"The running time of the train by which I traveled from Liverpool to London is four hours and twenty-five minutes, or a trifle more than forty-five miles per hour. Four stops were made, aggregating twelve minutes from full stop to starting. From Liverpool to Crewe—I do not know the distance, but it is something like fifty minutes' run—the train appeared to move slowly; average time was not made. For a time after leaving Crewe fifty miles an hour was made, with occasional spurts of sixty miles, though these were not plenty. Then, nearing London, the speed was not so high. We reached London ahead of time, and it appeared as though materially better time could have been made. But the train was not more than half the weight of American trains on roads that will compare somewhat with the London & Northwestern.

"I had read that the light English cars were unsteady at 50 to 60 miles per hour, the explanation being that they were not heavy enough to prevent excessive side motion and swaying. I found the car I was in to be quite the reverse of unsteady. There was no shaking up at stopping and starting, and when at speed the side motion was very slight. In getting away from stations, over switches, etc., there was some tendency to unsteadiness—rather more than in the case of a heavy car—but I found quite as little trouble in writing under full speed as in American cars on the best roads.

As far as I have seen, all English passenger trains are light in comparison with American trains, and the roads are straighter and with less grade. In building railroads here, when they come to a hill they go through it, not over it or around it. It does not seem possible to make the time on American roads with the heavy trains that is made here with the light ones. I mean the time that is made by some of the fastest English trains, or the average time of all trains. English locomotives, with their large driving-wheels, are not fit for train service on American roads, nor are American locomotives fit for service here. Put an English locomotive on an American train, and the important element of piston speed is lacking while getting up to speed from a stop. The engine exerts too little power when running slow. But with an English train the exertion of much less power is required to get the speed up. It makes a difference whether the work in eight cylinders full of steam can be used in going a certain distance, or only those in five or five and a half cylinders full.

"With the American engine on the English train there is, at the high speed of English trains, too great piston speed. The distribution of steam is not satisfactory nor economical. When the speed of any engine is so great that the loss in getting steam into and out of the cylinder is excessive, no one would expect to gain much power by increasing the speed. It would be lost in the work of taking care of the steam and in increased friction. Putting out of sight the rather confusing idea of leverage, and coming down to the quantity of steam handled for a given motion ahead of the train, seems to me to make it clear why the English locomotive, with its large wheels, is not suited to get heavy American trains up to speed in reasonable time. Then consider the loss involved in trying to get steam into and out of small ports at too high piston speed, and the loss in friction incident to the more rapid motion of parts under friction, and it seems plain that American express locomotives are not fit for English trains. The systems of train service are quite different in the two countries. In America it is heavy trains, small driving-wheels and necessarily moderate speed. In England, light trains, large wheels and high speed. Here again it appears that things are best adapted to the different practice of the two countries.

"After seeing some hundreds of English locomotives, they look better than at first. They have the appearance of being made for business. The little round-topped dome looks strong and substantial, if not ornamental. I have seen some locomotives in which the dome was covered with polished brass, the shape conforming to that of the dome. I must say that I have never seen anything that looked worse. The dome of an English locomotive was never made for an ornamental purpose."

Communications.

Places for Holding Conventions.

Editor National Car and Locomotive Builder:

I am in perfect conformity with the position you take in the last paper about the desirability of holding the two conventions at the same time and place; but I would go farther still and hold the conventions always in one city. A place for holding the conventions at annually ought to be selected in a central situation, and something might be done to secure permanent headquarters for both associations. The Master Mechanics' Association has a fund which could be used as a nucleus for raising sufficient money to buy a building, and there would be no difficulty in getting railroad companies and others to contribute the rest. A building of this kind is urgently needed in such a city as Chicago, and it could be used for a great many purposes that would make it a good investment and self-sustaining.

The idea of obtaining a permanent home for the associations is secondary to that of having them meet annually in some city which could be reached conveniently by the members. The majority of the members of both associations appear to be in favor of holding both conventions at the same time and place, and it only wants some work to concentrate the sentiment and lead to combined action. I have the best of reasons for knowing that many railroad general officers would like to see both conventions held together, and it would be prudent for the associations to give some heed to this desire.

I think it was very unfortunate that the two associations have voted to hold the conventions at different Southern cities next year. The experience of the Washington convention ought to have warned the associations against going south at that season of the year. I would be quite willing to compliment our Southern friends by going south, if peripatetic conventions are to be continued; but if we go there let the meetings be held not later than May, and when that is mentioned, why not hold the conventions always in May? It is generally admitted that a mistake has been made in arranging to have the Master Car Builders' Convention in Charleston and the Master Mechanics' Convention at Chattanooga; now why persist in the mistake? It would be an easy matter and a graceful proceeding for the committee of the Master Mechanics' Association to accept the inevitable, and hold their convention at Charleston. I think the Master Carbuilders acted in a painfully unbusiness-like manner in suspending their rules to make Charleston the place of meeting beyond recall; but it is done now, and as the deciding of the place for holding the Master Mechanics' meeting is still open, it would be the course of common sense and good business for the committee having the matter in charge to decide on Charleston. I regard it as your bounden duty as a paper read by most master carbuilders and master mechanics to advocate the holding of both conventions at Charleston. Harmony.

[We agree with our correspondent about the desirability of holding both conventions at one place next year, but the settling of it that way is not so easily done as he supposes. The Railway Master Mechanics' Association have ordered their Executive Committee to arrange for holding next convention at one of three places, viz., Chattanooga, Buffalo and Montreal. The committee have no authority to select Charleston.—Ed.]

A Confession.

Editor National Car and Locomotive Builder:

Feeling that my end is drawing near, and that my days of usefulness (?) are past, I am moved to make a full and free confession of my acts and doings. I *am* not a bad man, neither have I been, but my lot has been cast among those who were more prone to search for lucre than to guard the interests of others that were committed to their charge. I have spent my life as superintendent of Skrap, Heep & Co., manufacturers of car wheels. In the early days, before scientific men began to meddle with affairs, and some busybody invented the drop test; when times were booming and railroads had not yet learned to cut rates and shave prices, we made a good and fairly honest wheel, and one that no one need be ashamed of. To be sure, we held our trade by our low prices, and perhaps our wheels were never as good as those of Hi. Grade & Co.'s.

The Klosbier Railroad Company was our principal customer, and we were glad to sell them a five hundred pound wheel for nine dollars when other makers were getting eleven. But suddenly some one got the ear of the purchasing agent and sold him a lot of wheels for six dollars and seventy cents. This was too low for us even, and we were told that until we could meet these figures we could sell no more wheels to the Klosbier Railroad.

Here it was that my genius was called into play. How were we to make a car wheel for six dollars and three-quarters and have any margin of profit? A series of experiments with Indiana spar showed the way, and I succeeded in getting a neat-looking chill out of old stove plate and miscellaneous scrap. Then it was that we came upon the market with a six-dollar-and-a-half wheel, and carried ninety-nine per cent. scrap in the cupola. But there was money in the business, and we had no reputation to gain or lose.

We would have been all right had not the Klosbier Railroad taken it into its official head to require a drop test on all wheels. Our wheels went to smash at the first blow, and we again went out of the business. I could make a first-class chill out of stove metal, and our lucky stars had protected us from the results of an investigation that would have followed an accident resulting from a breakage of one of our wheels. Still, we could not stand the drop test. Six dollars and a half, minus profit, will not make a wheel that will stand that banging; so now, when the Klosbier is poor, they do not require the drop test, the fires are kindled in the cupola of Skrap, Heep & Co., and their business flourishes; but when the railroad has more money, the drop test is again stipulated and we go out of the business, while I take a vacation.

We must make a living, you know, and public sympathy must certainly be against a railroad that will deliberately choke off a poor man because his products are not quite as good as those of his richer competitors.

R. E. Gardless.

Effect of the Luttgens Damper.

Editor of the National Car and Locomotive Builder:

In speaking to some of the master mechanics at the convention, I find that they consider my exhaust damper simply a substitute for a variable exhaust, and another more interesting *opinion* is, that whoever finds a saving in fuel by means of the damper puts his foot in it, as it only shows that too small an exhaust nozzle is being used on the engine.

My claim for the damper as a fuel saver is based upon facts known to me several years before I hit upon the form of damper for locomotives.

A sleeve provided with holes, fitted to an ordinary pipe, the pipe being provided with corresponding holes, has a very peculiar effect upon the fire of a stove, heater or stationary boiler, the mode of application for a 17 or 20 diameter stack being different. It produces a large saving in fuel.

Putting on fresh coal with the damper open, with all the common dampers closed, the coal will remain apparently in its natural condition for 8 hours, more or less, black, without being burnt, a bright fire remaining underneath the coal, at the same time giving a considerable amount of heat.

If the coal is urged to a bright fire before the damper is opened the fire will then remain in the same bright condition for many hours.

The fact is that a coal fire in this way can be made to burn very slow, burning the coal to the best advantage, producing the greatest amount of heat for the amount of coal used.

All modern devices for economizing fuel, regulating stoves and other apparatus for heating dwellings are based upon this principle, though its application is not so obvious as in the device above referred to; so that I claim that the method of admitting air at the base of the locomotive stack has a distinct and peculiar effect upon the fire, whereby a considerable saving of fuel is produced, independent of the size of the exhaust nozzle used.

This fact is fully demonstrated on a number of fast passenger engines now running near the city of New York, which do very heavy and fast service, and where after the exhaust nozzle has been adjusted to suit the varying conditions of the road, taking into account changes in the weather, it is yet found that these engines can be run with the damper fully open, a slight contraction of the openings being occasionally needed for urging the fire and with the best results to the fuel account, with other attending benefits by the use of the damper. H. A. Luttgens.

Warping of Lumber.

It is generally believed that the cause of a board's warping is the swelling of the fibres on either side, due to the wetting of that side. While in extreme cases this is true, most lumber when laid away where it is protected from the possibility of being wet on either side will absorb moisture from the air as equally on both sides as the nature of the material will permit; and yet it has been found that such boards will become at least slightly warped. In the case of thin boards the curve is harmless, being easily corrected, but in the case of thick boards, or wide, thick timber, the warp is incurable.

Never having seen any discussion of the subject, the writer has been led to make a number of observations on the direction of the warp. It is evident that, in sawing logs, only one board can be cut containing the center of the tree. Examination of the end of that board will show a small ring at the center, with other rings and parts of rings, until near the edges of the board the rings of growth will appear as lines passing squarely across the board, especially if the tree was of large diameter. If the board was cut some distance from the centre of the tree the rings will appear as curved lines entering one side of the board, passing partly or entirely across the end and curving back to the same side, showing which side of the board was toward the centre of the tree before cutting. For convenience we will call this the inside of the board.

Examination of the ends of a great number of pieces, more or less warped from one cause or another, has shown, without exception, that the curve due to the warping was opposite to the curve of the rings of growth. That is, if two warped boards are placed with the concave sides together, examination of the ends will show the curves of the rings of growth with their convex sides together. The rings on the two boards will be closer together at the center than at the edges of the boards. This would appear to show that the fibers on the inside of a board either absorb moisture more freely, or swell more with the same amount of moisture, than the fibers of the outside; the result being that the absorption of moisture by timber tends to straighten out the curves of the rings of growth. We may conclude from this that warping may be prevented to a large extent, especially where it is desirable to avoid crossing the grain, by gluing the boards together with their outside faces in contact, especial care being taken to avoid placing an inside face in contact with an outside face. It is best to place concave faces together, so the tendency to separate will be greatest at the center, rather than at the edge.

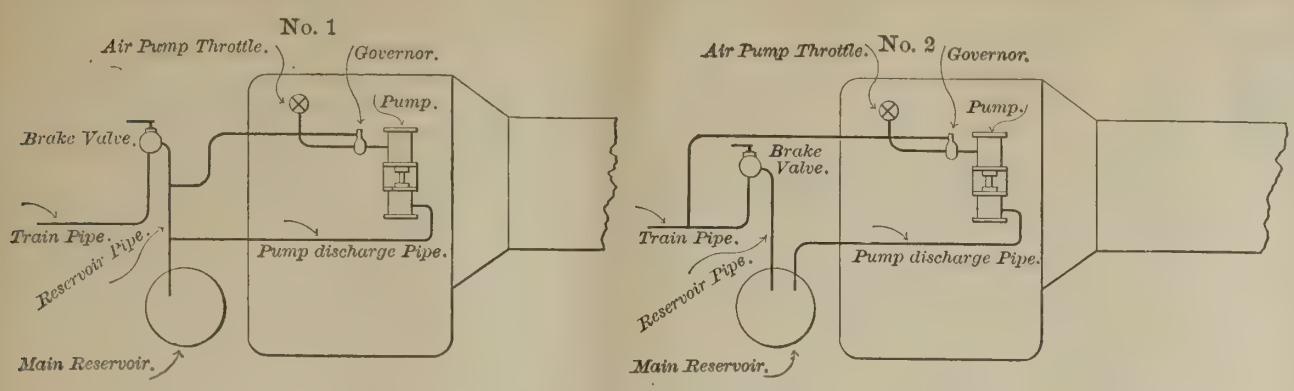
We would also conclude that, when boards are to be veneered on one side only, that the veneer should be placed on the "inside" of the board, so that the "draw" of the shrinking veneer will tend to counteract the warp. I have failed to discover if there is any especial rule among veneer layers in selecting the side of the board in veneering.—*C. J. Bates in Gazette.*

The International Manufacturing Association, 10 Wall street, New York, is a responsible corporation formed to "encourage the inventors of mechanical devices and act as a medium for pushing approved devices." It is prepared to investigate the commercial value of inventions and furnish the capital or facilities for testing and introducing them. The officers are: Edmund C. Stanton, president; John H. Montgomery, vice-president; Louis M. Howland, treasurer; Henry K. Gilman, secretary and general manager; Benjamin S. Church, consulting engineer.

The Inter-state Commerce Commissioners appear to be daily displaying more inclination to extend their authority over railroad companies beyond what most people believed to be the purpose of their creation. If they can make the relations between railways and their employés or the public more harmonious there will be no objection to the interference. They are about to issue two circular letters. One, to be addressed to railroad employés, is a request for information about accident associations that exist in different companies, and for information on the apprentice system, and the manner of promotion. The circular meant for the company's officers is similar. It asks for details of all insurance schemes and their operations, and concerning technical training that may or may not be a feature in the company's shops. This letter also asks concerning eating houses for railroad men when they are away from home.

On Saturday, June 22, the Baldwin Locomotive Works received an order from Mr. Robert H. Coleman, of Cornwall, Pa., for a passenger locomotive for the Cornwall & Lebanon Railroad Company's narrow gauge extension to the summit of Mt. Gretna. The locomotive was to be of the American type, with eight-wheeled tender, equipped with Westinghouse air-brake, and all the improvements in use on standard gauge passenger locomotives of the highest class. The materials for this locomotive were ordered from the respective manufacturers the same day. The boiler-plates were received at the works on Tuesday, June 25, and the complete boiler was taken into the erecting shop on the evening of June 28. The locomotive was tried under steam on Monday, July 1, with the wheels under it. The tank plates arrived on Friday, June 28. The hand rails, wheel covers, bell, number plate and many other details of the finish were nickel-plated. The boiler and smoke-box were lagged with asbestos and jacketed with planished iron. The locomotive and tender were finished on the evening of July 2, and shipped on the morning of the 3d. They reached Lebanon the same evening, and were in service on the Fourth of July.

At an after-dinner speech at Crewe, before the visiting American engineers, Mr. F. W. Webb, locomotive and car superintendent of the London & Northwestern Railway, stated the following: The company has a capital of $528,000,000, annual revenue, $51,500,000, and annual expenditure, $26,500,000. The number of persons employed by the company is 60,000; in locomotive department, 16,000; miles operated, 2,500; stations, 800; signal levers in use, 30,000; lamps lighted every night, 13,500; cabins, 1,400. The number of passengers carried annually is 57,000,000; weight of tickets issued, 50 tons; number of tons of goods and minerals carried, 36,000,000 annually; engine mileage per year, 55,525,334. Last month, with a mileage of 4,750,000, they had with the passenger trains only one hot crank pin, and with the goods trains two such failures, and they had only one failure of a connecting rod for both goods and passenger trains. The number of tons of water consumed was 20,000 per day; coal used, 2,700 tons per day; pounds of water evaporated per pound of coal used, 7.45. During the year, beyond the ordinary services they had run 41,314 special passenger trains, 47,238 special goods trains, 78,285 special cattle and mineral trains; total, 166,832 trains. The company owns 53,000 freight cars, 5,600 passenger coaches, 3,200 horses, 3,100 carts, 2,500 locomotives and 20 steamships. Crewe Engine Works occupy 116 acres of ground, the covered area being 36 acres.



WESTINGHOUSE BRAKE CONNECTIONS.

A great many of our readers will find information that will be of value to them in the following notice sent out by the Westinghouse Air Brake Company:

We are occasionally in receipt of inquiries from railway officials as to causes of some supposed defect in devices employed in our brake system, which, upon investigation, is sometimes found to be due to improper methods of attaching the apparatus to an engine or car.

One of the most prolific sources of trouble arises from improperly arranged pipe connections on the locomotive, where the pump discharge pipe and the pipe leading to the engineer's brake valve are united, instead of which independent pipes for each purpose connecting with the main reservoir should be used, and for which we provide an ample amount of pipe and the necessary union connections. The following sketches will serve to make our reference clear:

When the improper plan (No. 1) is used, quite an amount of moisture and filth from the pump is carried directly to the engineer's brake valve, and to the brake apparatus on the train vehicles, to such an extent as to sometimes impair their efficiency.

When the proper method (No. 2) is used, the objectionable matter is deposited in the main reservoir, from which it may be drained at will by unscrewing the plug, which should be placed in some convenient and readily accessible position. We have also frequently found the pipe to the air-pump governors connected to the main reservoir. This should invariably be connected to the train pipe, a union connection being provided at the engineer's brake valve, which communicates with the train pipe. The sketches will also show proper and improper methods of connecting the air pump governor, and should be considered illustrative only of the points we wish to convey. Proper union connections are provided at the brake valve for the gauge and governor.

A French Compound Locomotive.

An eight-wheel coupled freight locomotive belonging to the Northern Railway of France was lately converted into a compound, the cylinders being arranged tandem. After conversion the engines weighed 56 tons, all the weight resting on the drivers.

The cylinders of the original engine were 19.68 inches in diameter, with 25.59 inches of stroke, and wheels 51.18 inches in diameter. As compounded, the first and second cylinders, in tandem, were 15 inches and 26 inches in diameter, with the same stroke as before, 25.59 inches; the capacity ratio of the cylinders being 3. These dimensions are the result of elaborate calculation based on indicator diagrams taken from the cylinders of the original engine. The cylinders are placed outside the frame-plates, and the second or larger cylinder is placed at the front. They are joined together, forming a diaphragm partition common to both; and the second piston is provided with two piston rods, which pass back, flanking the first cylinder, and are, with the piston rod of the first cylinder, fastened to a cross head common to both. The two cylinders have but one valve chest and one slide valve, worked by the link-motion. The valve is formed double to provide passageways between the cylinders and for the exhaustion into the chimney. For the second cylinder the Trick principle of double entry is provided. The steam ports are unusually wide, 17¼ inches, for ready ingress and egress of steam. The valve is balanced, for the most part, by the removal of the pressure on the back by a packing ring for a circular area 19 inches in diameter. Through an automatic piston valve, air is admitted into the cylinders when the steam is shut off. Steam can be admitted direct into the second cylinder when required.

During the month of January, 1888, the compound locomotive was tested daily with regular coal trains of sixty wagons (900 tons), from Lens to Longueau, 106 miles going and returning. The gross consumption of fuel was at the rate of 50 pounds of coal per mile. By the results of comparative trials of the ordinary and the compound locomotive, given in detailed tables, it is shown that a saving of fuel of from 13½ per cent. to 26 per cent., according to the weight of the trains, is effected, in favor of the compound system. These results, deduced from the actual performance of the engines, are corroborated by analyses of the indicator diagrams, which show an economy of from 3.20 per cent. to 26.4 per cent.; with speeds of from 10 miles to 13 miles per hour on levels and ascending inclines for the ordinary machine, and from 8 miles to 22 miles per hour for the compound machine.

Two hundred box cars have just been ordered by the Evansville & Terre Haute.

The New York, Ontario & Western are having a new officers' car built at Wilmington, Del.

The Erie Car Works just finished the contract for ice cars for the Silver Lake Railroad, and will at once begin on a contract for 200 gondola cars for the same road. It is a small line running from Rochester to Spring Lake, N. Y.

Work has been commenced upon the construction of the Union Pacific shops at Cheyenne, Wyo. The corner stone was laid July 10, and the occasion was made a holiday in the city. There was a large parade and the business houses and residences were profusely decorated in honor of the occasion.

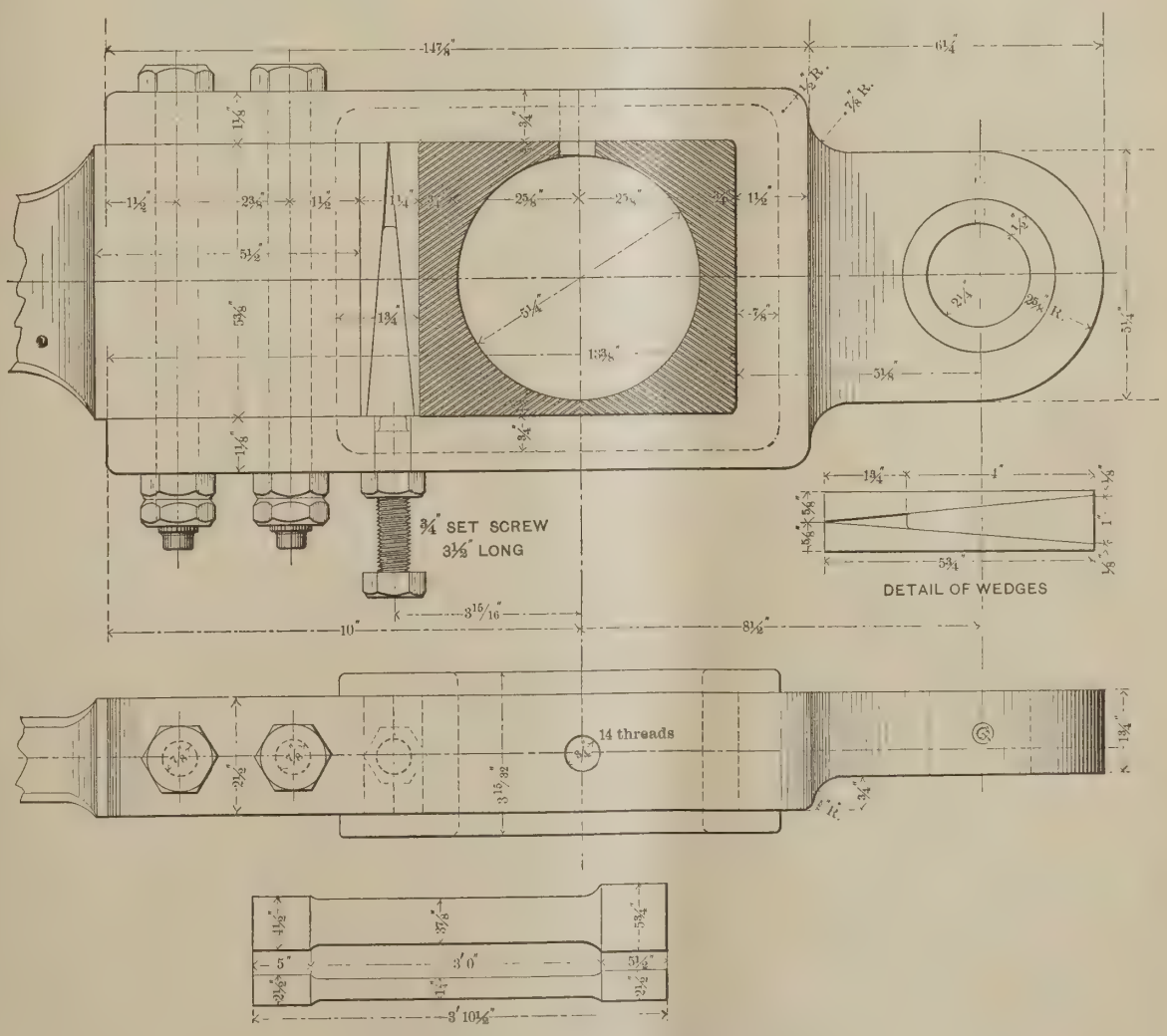
The New York Locomotive Works, Rome, N. Y., has just delivered to the New York & New England two new freight locomotives, weighing 65 tons each. The road is to have five more machines of the same pattern. Negotiations are pending with the Union Pacific for the construction of a number of consolidated locomotives, to weigh 75 tons each.

The Louisville & Nashville Railroad Company will spend $215,000 in reballasting different parts of its tracks, and $350,000 in improving bridges and building new ones of iron. Contracts have been given to the Louisville Bridge & Iron Company; the Detroit Bridge Company, Detroit, Mich., the Schiffler Bridge Company, of Pittsburgh, Pa., and Phœnix Bridge Company, of Phœnixville, Pa.

The new car and repair shops of the Long Island Railroad at Richmond Hill are well on toward completion. The engine-room, whence the power is to come for hoisting the locomotives when they need to be overhauled, and for running the big lathes, has a brick chimney 125 feet high. The company has just begun to remove the machinery from the shops at Long Island City to the new works at Richmond Hill.

The Erie Car Heating Company, Chicago and Erie, Pa., has an arrangement for heating railway cars with steam from the locomotive without the use of rubber hose or ground metallic joints. This is done by passing the steam through coils of seamless brass tubing placed one under each platform of every car, and which readily meet all possible sider and vertical motions between the cars. Slip-joints, to meet the end motion, are so constructed that in case the train parts, the plunger will pull out without disturbing the packing, and can be inserted again in an instant, when they will be steam-tight the same as before.

A correspondent of the *Coal Trade Journal* says that Mr. Charles Mackall, of Baltimore, a mine operator and handler of coal, has invented and patented what he calls a "combination freight car—that is, a car combining all the qualities of a box car, gondola and hopper in one. This car fills a long-felt want for handling coal, ore, sand, grain, or any rough material that can be spouted direct from car into cart, wagon or vessel. This car is made in three sections or parts on a solid frame; each hopper carries 13⅛ tons of coal, or 40 tons to the car. The hopper is raised from the truck by suitable machinery to such an elevation or angle as to allow the contents to be discharged without shoveling by placing a schute under the opening at the bottom of the hopper. The mechanism is simple, strong and well calculated to withstand the hard usage to which such cars are subjected. It is also provided with a sliding door, on an inclined or slanting roof, fitted in such a way as to make it water tight. The car is built of iron, owing to the fact that iron is cheaper and stronger than wood.



MOGUL ENGINE ROD CONNECTIONS.

Annexed engraving shows the style of rod connection used for the middle wheel of mogul and ten wheel engines on the Cincinnati, New Orleans & Texas Pacific. The peculiar feature about the thing is the manner in which wedges are used to fill up the space between the stub end of the rod and the brass. As will be seen from the cut, three wedges are used for this purpose, the advantage of the three being that they insure parallel faces and an easy moment of the center wedge for the taking up of slack Two wedges were used by Mr. Meehan for years, but he found the third one such a decided improvement that he now uses the arrangement as shown on all his engines, having more than two pairs of wheels coupled.

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EDITORIAL ANNOUNCEMENTS.

Advertisements.—*Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING COLUMNS. *The editorial department will contain our own views and opinions; and the rest of the reading matter, aside from advertisements, will be such as we consider of interest to our readers.*

Contributions.—*Articles relating to railway rolling stock construction and management, and kindred topics, by those who are practically acquainted with these subjects, are especially desired. Also early notices of changes in railroad officers, organizations and names of companies.*

Special Notice.—*As the* CAR AND LOCOMOTIVE BUILDER *is printed and ready for mailing on the last day of the month, advertisements, correspondence, etc., intended for insertion, must be received not later than the 25th day of each month.*

Work for the Master Mechanics' Association.

In another part of this paper will be found the list of subjects as arranged for investigation during the coming year by the Railway Master Mechanics' Association, and the committees appointed to do the work and prepare reports for discussion at next convention. There are eleven subjects laid down for investigation, and one more that was recommended by the Committee on Subjects has been incorporated with the work of Committee No. 1, so there is likely to be business enough brought before the next convention to make an interesting meeting, and to keep those who attend well engaged. Some of the subjects to be discussed have been repeatedly before the association, but they are brought up more because sentiment has not settled down decidedly upon what is the best practice in the line they relate to than for want of other line subjects, and renewed discussion of them will help to decide questions still in doubt.

The first subject on the list—Exhaust pipes, nozzles and steam passages; best form and size in proportion to cylinders—is carried over from last year, with the part relating to steam passages added. The subject is of very great importance, and is discussed at greater length elsewhere.

The second subject—Componnd locomotives—brings up for investigation and discussion a subject which for several years has been engaging the attention of the ablest engineering talent in Europe, and has now, by the force of cir cumstances, pushed itself upon American engineers in such a way that they must give a practical answer to the question—Can compound locomotives be used acceptably and economically for handling our trains? It is highly proper that the Railway Master Mechanics' Association should undertake to find out whether or not compound locomotives are likely to be more economical than simple engines. The testimony that comes from those who are using compound locomotives appears to show that this form of engine materially reduces the quantity of fuel required for doing a given measure of work; but on the other hand, there are numerous allegations that compound locomotives receive special favor and nursing not extended to common simple engines, and that a considerable share of the saving is due to conditions unfair as a basis of comparison. It will be the business of the committee to find out the truth, and we feel assured that Mr. J. Davis Barnett and his associates will present a report which will contain valuable guidance for the railroad men of America.

"Testing laboratories, chemical and mechanical," is a new subject, and the report thereon will bring up for discussion the value of establishments about which there exists great diversity of opinion among railroad men. Mr. Philip Wallace, chairman of this committee, has had a great deal of practical experience with laboratories, and few men are better able to report intelligently on the advantages which railroad companies derive, or are likely to derive, from having the supplies and material they use properly tested.

Subjects 4, 7 and 9, which introduce respectively, "Efficiency of the link as compared with other valve motions," "Relative value of steel and iron axles," "Brick arches in locomotive fire-boxes," "Purification or softening of feed water," and "The best form and size of axles for heavy tenders," have all been discussed in connection with previous reports, but they are all still of living interest.

There is a decided tendency among many master mechanics to raise the fire-box entirely above the frames, for the purpose of increasing the fire grate area, while others are no less firmly opposed to the practice, holding that the change of design involved losses that are not overbalanced by the gains. This form of construction is yet to a great extent experimental, and that being the case it was seasonable for the association to investigate the "advantages and disadvantages of placing the fire-box above the frames."

"The best means, and the economy of preserving locomotive tanks from corrosion," is a subject which deals with a matter that is often very much neglected. With some kinds of fuel the inside sheets of locomotive tanks last but a very short time before they need patching. There are also certain practices followed of securing the tank to the frame which lead to extremely rapid corrosion of the bottom and corners. It goes without saying that it pays to prevent corrosion, and it is likely that members who succeed in preserving their tank sheets to a good old age may impart valuable information to those who are constantly kept laboring on tank repairs without getting in advance of urgent calls for work in this direction. On some roads nearly all the tenders always appear to be leaking, making the track about stations dangerously slippery in winter, and keeping the rails in a moist condition at all times. The attention of the Master Mechanics' Association has not been directed to this subject any too soon.

"The present status of the automatic car-coupler question, and whether the association can indorse the action of the M. C. B. Association in recommending the vertical plane standard from a mechanical standpoint," is a delicate subject at this time; but as all the members of the Master Mechanics' Association are just as deeply interested in the successful working of car couplers, and quite as able to sit in judgment upon their merits as the men who established the standard, we can see no reasons why the investigations of this committee should not be useful and profitable.

The innovation of appointing an associate member upon each committee of investigation will commend itself to the active members who think that the associate members have in the past received gratuitous honor from the Association without giving anything in return. It will now be the fault of the chairmen of committees if associates are not made useful wheels to accelerate the progress of the Association.

Prospects of Rolling Stock Building.

The depression in car and locomotive building appears to be nearly over, for most car works are now busy, and inquiries for new engines are said to have been very numerous lately, and orders are beginning to increase in number. It looks, however, as if many railroad managers intended to repeat the performance of former years, when a revival of business came round, and wait till their roads are getting blocked with freight before ordering the motive power necessary to move the cars that have to be hauled. The inducements that follow this practice are in many cases exceedingly strong, for when earnings have been small it is natural that managers should delay the incurring of expenditure for new rolling stock till it is certain to be needed, and the uncertainty of crops being safely harvested makes it prudent to delay ordering equipment till the prospects of business are beyond peradventure. But those who delay ordering rolling stock till immediate delivery becomes of the utmost importance, generally have to pay a premium on their purchases, and it is quite proper that they should have to do so, for car and locomotive builders cannot rush business and work nights without extra expense.

This period of depression in the building of railroad rolling stock has been materially lightened, and the season of prosperity accelerated by the business resulting from the development and growing prosperity of Southern railroad systems. In the future, when increased mileage and greatly augmented business shall make Southern railroad companies good customers for builders of rolling stock, the business will have a decided influence in preventing the harassing fluctuations that have always characterized the demand for railroad rolling stock. The railroad companies with lines in the Northern and Middle States were for years the principal buyers of rolling stock. A failure of crops in the West has always had such a malign influence on the railroads referred to, that a cessation of track building and extension would ensue, and the ordering of new rolling stock would cease. The result was that the builders of rolling stock have generally had a feast or a famine in their business. The experience of the last few years has shown that Southern railroads are little influenced by the events which cause depression on Northern lines. Among the orders for cars and locomotives placed during the last year, Southern railroad companies have held prominent places, and they are still keeping to the front. The Central Georgia has made and is still making large additions to the rolling stock, the Savannah, Florida & Western has ordered or is in the market for 36 locomotives, and the Wilmington & Weldon has just contracted for the building of 19 locomotives. These are among the most recent demands for locomotives, but other important orders have lately come from the Texas & Pacific, the Charleston & Savannah, the Mississippi, Kansas & Texas, the Louisville & Nashville, the Cincinnati, New Orleans & Texas Pacific, and many others. The demand for cars has kept up with that for locomotives, and the prospect is that it will keep increasing for some time to come. If the demands of Northern companies become as urgent as they generally are in the beginning of a busy season, the fall will find us with another boom in car and locomotive building.

Exhaust Pipes, Nozzles and Steam Passages.

The exhaust pipes and nozzles of a locomotive engine perform very important functions besides that of passing the steam from the cylinders to the atmosphere, but unfortunately the locomotive engineering world has never given this part of the engine the attention it deserves. Next to the invention of the tubular boiler, the intense draft induced by passing the exhaust steam through the smoke stack proved of the greatest service in making the locomotive a successful engine. The tubular boiler and the steam blast provided for extraordinarily rapid generation of steam with the small boiler, that it was practical to carry on a movable machine, and they are two of the essential elements of even a moderate speed locomotive. When the improvement of passing the exhaust steam through the chimney was first introduced, the engineers of the time supposed it mattered little how the exhaust pipes were located so long as the steam was passed in with sufficient velocity to cause a rapid rush of the fire gases through the flue tubes. They very soon discovered, however, that when the boiler was deficient in steam-making capacity compared with the demands of the cylinders, that the generating power could be stimulated by restricting the exhaust opening. This quickly became a popular mode of increasing the steam-making capacity of boilers, and the injudicious use of this means has led to enormous waste of fuel. Generations of men in charge of locomotives have found closing the nozzles a convenient and easy means of stimulating steam making, and it has been constantly resorted to when those anxious to obtain a greater supply of steam ought to have been searching for the means of imparting to the water more of the heat of the fuel burned, instead of providing the means of burning more coal. In this country, inordinate consumption of fuel in proportion to the work done put very little restraint on bad proportions of draft appliances. The first check met with by those who favored the use of small nozzles was in the dangerous throwing of sparks carried through the tubes by the sharp blast; the second check to the restricted escape of steam from the cylinders was the loss of power caused by excessive back pressure in the cylinders.

A careful study of the development of the American locomotive appears to show that the able mechanical engineers who have brought the engine to its present high standing have been singularly apathetic about improving the draft appliances. Many of the men who have been leaders in carrying out improvements on other parts of the machines were well versed in the laws relating to induced currents, and they must have been aware of the influence that the form of an exhaust tube has on the height of the vacuum created, yet they were contented to press the steam from cylinders of locomotives through the worst forms of passages and openings. No end of ingenious labor was devoted to preventing the sparks from escaping through the smoke stack that a viciously sharp blast had drawn through the flues; double nozzles were invented to prevent ruinous back pressure in the cylinders, which would have resulted from both cylinders exhausting through one small nozzle; but no labor to speak of was expended on trying to improve the design of the parts that tended to cause so much fire throwing and piston resistance. Although the effect of small changes on the exhaust pipes and nozzles of locomotives has always been apparent enough to excite attention, and although the influence of these parts has always been highly conspicuous on the economical operation of the engine, they have been strangely neglected considering their obvious importance, for the subject was never suggested for investigation by the Master Mechanics' Association till a year ago. The best form of exhaust nozzles was once brought up for discussion, owing to a paper being read from a very able member of the association who assailed the use of double nozzles; but the speakers who expressed their views on the subject appeared to have had no conception that the form of nozzle was of any importance so long as it made the engine steam.

There seemed until quite lately to be nearly as much carelessness displayed about the form and size of steam passages as there was about exhaust pipes and nozzles. Some makers repeatedly enlarged their cylinders and retained the same size of steam passages for 20-inch cylinders that had been none too ample for the steam used to supply 16-inch cylinders. There are to-day many large engines at work which have their power reduced by the chocking action of restricted steam passages.

During the last three or four years master mechanics appear to have made very great progress in realizing the importance of having ample steam passages, well-designed exhaust pipes and large nozzles, and there is a decided tendency manifested to experiment with a view of finding improved forms. It is to be regretted that the committee of the Master Mechanics' Association having this subject under investigation did not present a report at last convention, for we understand that the members have been making exhaustive experiments, and that they have found out valuable facts which will be of general interest. There are many other railroad men working in the same line of investigation, and we would suggest that those who have discovered anything new about exhaust pipes, nozzles and steam passages should give the committee, and through them the world at large, the benefit of their labors.

The Effect of Manganese on the Chill.

Some recent experiments on the effects of manganese on the chilling properties of iron show that its action is very peculiar. The iron used in these tests was the regular car wheel mixture of one of the companies whose wheels stand in the front rank both for strength and durability, so that the data obtained can only be considered applicable to high grades of iron. What it will do with poor scrap metal must be determined by those who are interested in that class of goods.

The experiments were tried with ladles full of iron sufficient for pouring a 550-pound wheel. Starting in with one pound of manganese and adding one-half pound more to each succeeding ladleful, it was found that there was no appreciable effect on the chill of the test pieces up to seven pounds and a half. From this point up to ten pounds the depths of the chill gradually increased from a trifle more than one-half inch to three-quarters of an inch.

The principal peculiarity noticed throughout was the fibrous extensions of the chill down into the gray iron, whereas the inner edge of the chill was straight and comparatively even where no manganese was used.

Car loads are now becoming so heavy that the necessity for a stronger axle than that which has been the M. C. B. standard for sixteen years is already urgent, and it is to be hoped that the axle sent to letter ballot by the Master Car-Builders' Association at the Saratoga Convention will receive the number of votes required to make it standard. Although the old standard axle is sufficiently strong for carrying loads under favorable circumstances up to 50,000 pounds, the tendency of freight shippers is to overload cars, and cars that are loaded away beyond the safe capacity of the running gear are becoming dangerously numerous. We learned particulars lately of a car that was loaded in Ohio with 35 tons of freight for a place in Vermont. The car was gone before the shippers discovered the extent of the weight that had been put in, and as the goods shipped were expensive and dangerous, the parties who were responsible for the mistake of overloading were extremely solicitous about the fate of the car. It went through to its destination without accident, however, and in the usual time, so it caused no delay by hot journals. Yet it was found that the car had old small axles with journals 3×6 inches. These axles must have been of better material than those usually made from the ordinary muck bar iron, but even then it was very much of an accident for the car to make the long journey without causing a wreck. While the case illustrates the heavy load that a good axle may carry, it also serves to show how little discrimination shippers and those that supply cars to them exercise about the kind of car used for carrying a heavy load. To most men one freight car is just as good as another, and when the practice is introduced of loading any car with 30 tons, the average shipper will put that weight on any car that is switched upon his siding. Hence comes the necessity for the general introduction of a heavier axle. If the axle soon to be voted upon becomes a standard, we are informed that many roads will specify it for all the cars they build.

Owing principally to defects caused by bad forms, there was a decided movement for several years against the use of steel in construction of railroad rolling stock. Pins and axles were finished with sharp corners where long fillet should have been, and a weak point for eventual fracture was provided; piston-rods and other parts were made so that the vibrations and movements of service concentrated in one point and breakage ensued. Owing to this, steel got into disrepute on many railroads, and it was abandoned in favor of good iron. Those who were careful with the designs of parts constructed of steel, however, have had the greatest satisfaction from its use, and now there appears to be a reaction getting in again favoring it. Every time we go visiting among railroad shops we see new evidences that steel is rapidly coming back into favor. The latest straw that we noticed showing this current, was in the Erie shops, where we found them using steel axles very largely for locomotive work. Some driving-axles they were putting in had wheel-seats $7\frac{7}{8}$ inches diameter and journals $7\frac{1}{2}$ inches. The cause of the change was the seamy condition into which even the best iron axles get after a few years' service. The want of homogenity of iron permits the severe twisting strains to which an axle is constantly subjected to separate the fibers of the material, and the seams that result make the surface of the journal rough, inducing great increase of friction that leads to heating. Steel axles do not disintegrate in this way.

The dispute which arose between the management of the Union Pacific and their locomotive engineers respecting the action of the general manager of the Leavenworth, Topeka & Southwestern in reducing the wages of enginemen has been settled by arbitration. Mr. G. W. Vroman, Chairman of the Grievance Committee of the Union Pacific engineers, writes us complaining about being called a "radical among radicals" in our July issue, and saying that we have done him injustice. He maintains that the Leavenworth divisions were operating under a schedule of pay arranged for the Union Pacific system, and that the agreement of this schedule was broken by the company without cause. That the grievance committee merely insisted that the schedule should be adhered to, and that he (Mr. Vroman) readily agreed to referring the dispute to arbitration, although there was nothing to arbitrate.

There is a general impression that the iron industries have been quite dull during the first half of this year, but now comes in the official returns of the American Iron and Steel Association, which show by figures that cannot lie that the quantity of pig iron produced has been greater than in any preceding half-year in the country's history. There is a decline of 40,000 tons in Bessemer pig, but an increase of 238,000 tons in foundry and mill iron over the last half of 1888, which had been the banner half-year. Of charcoal iron there was a small decrease, and also of anthracite and of mixed anthracite and coke iron, while of bituminous iron there was an increase of 288,000 net tons over the last half of 1888. This increase is the more remarkable because the larger production is usually, for climatic as well as commercial reasons, in the last half of the year. This gives conclusive evidence that the country is not in such a bad way as many croakers would like to make it out to be.

The Northeastern States have been supplied this season with an unusual quantity of early peaches, carried North from Georgia and other Southern States in refrigerator cars. There is a good market for this fruit, and the business of supplying it is growing, but the development of the trade has been much slower than it ought to have been. To assure successful handling of the fruit, cooling houses have to be provided at the points of shipment and refrigerator cars to maintain an even low temperature of the fruit during transportation. Common express cars sometimes bring the fruit through all right, but it is frequently ruined; and the uncertainty has for years depressed a business that has great possibilities if properly managed.

There happened during last month several fatal accidents through vehicles being struck at level crossings by trains while attempting to cross the track, and the public is being rapidly educated up to a realizing sense of the dangers of level crossings. In the crowded portions of the New England States the dangerous nature of level crossings has long been recognized, and legislation has stimulated many railroad companies to provide the public with safe means of crossing the tracks. In some cases the legislation was very sweeping and unjust to railroad companies. If those who are not yet compelled to make crossings safe would display a disposition to protect the most dangerous crossings it might be the means of delaying legislation which is not likely when it comes to be discriminating about necessary and unnecessary expenditures. There are hundreds of crossings that are entirely unprotected, where it is impossible for those driving to see the approach of a train until the horses are on the track, and yet no inclination is displayed by the responsible parties to remove the obstructions to vision, which in many cases could be done at trifling expense. In the middle of July four persons were killed on the New York & Long Branch Railroad at a most dangerous crossing which, of course, was unprotected. The coroner's jury held the railroad company to blame for the accident, and they will probably have to pay heavy damages; but if real justice had been done, the president of the company would have been punished for manslaughter.

Mr. A. Mallet, the celebrated French engineer, author of a well-known book on compound locomotives, has translated into French the paper on compound locomotives read by Angus Sinclair before the New England Railroad Club in April last. Mr. Mallet commends the paper very highly, and says, although it is short, it is a very clear, precise and impartial account of compound locomotives. He adds a number of notes commenting on the statements made in the paper, and publishes engravings illustrating the valve arrangement of compound locomotives of his design. Respecting the statement in the paper that all compound locomotives have the starting power materially reduced after the first turn of the driving wheels, Mr. Mallet says: "This is applicable only to the Von Borries, Worsdell and other systems. On the contrary, we are always careful in the two-cylinder locomotives constructed or transformed by us, to arrange for the steam being passed direct on to the low-pressure cylinder as long as desired, or in case of accident. By the movement of a lever the compound machine can be transformed into an ordinary engine.

"Our system fulfills absolutely the conditions laid down by Mr. Sinclair (as necessary for a successful compound locomotive), and has been in use for more than twelve years. We are far from doubting the ingenuity of American designers, but in this case it does not need to be exercised."

When we read that the managers of the leading trunk lines have entered into an agreement to refuse to receive and transport certain loaded private stock cars, it looks as if the railroad officials were combining to defy the letter as well as the spirit of the Inter-state Commerce law. If railroad companies follow the practice of hauling any kind of private cars, it is discrimination of the worst kind to say that certain private cars should not be transported on equal terms. We are all aware that in the past a great deal of unfair treatment has been given to parties who did not happen to be favored by railroad magnates, and there is no doubt but it was just such high-handed tyrannical actions which generated in the public mind a demand for legislative enactment which led to the passage of the Inter-State Commerce law. We supposed that the law in question had ended the worst abuses of discrimination, but it seems we were mistaken, for parties in Chicago have just been under the necessity of appealing to the courts to compel the Delaware, Lackawanna & Western Railroad Company to haul their private stock cars. In all probability the court will issue the mandate requested, and legislators will regard the need for the appeal as another reason for putting renewed restrictions upon all railroad companies.

Personal.

Mr. Francis F. R. Brown has resigned the position of mechanical superintendent of the Canadian Pacific to become superintendent of the Dominion Bridge Company, Montreal. Mr. Brown is regarded as one of the ablest mechanical engineers on this continent.

In our list of members who attended the Master Mechanics' Convention at Niagara Falls the names of Mr. T. W. Gentry, Richmond & Danville; T. A. Fraser, Minneapolis, St. Paul & Sault Ste. Marie; Wm. Fuller, Cleveland, and W. Garstang, Chesapeake & Ohio, were by mistake left out.

It is stated that John Kirby, general master car-builder of the Lake Shore & Michigan Southern, has resigned, and that he will be succeeded by John Patterson, late master mechanic of the Cincinnati, Indianapolis, St. Louis & Chicago. Mr. Kirby resigns, we understand, with the purpose of retiring from railroad work.

A considerable part of the success of the Saratoga convention was due to the efforts made by Mr. R. C. Blackall, superintendent of motive power of the Delaware & Hudson Canal Company. The parties who were benefited by Mr. Blackall's labors showed their sense of appreciation of his work by presenting him on the last day with a handsome gold watch and chain.

Mr. John Player, superintendent of motive power on the Wisconsin Central, will take the steamer at New York on August 7, for a visit to Europe. Mr. Player has taken a keen interest in compound locomotives, and expects to glean some information about them during his visit to the Fatherland which may be of use to the committee on compound locomotives, of which he is a member.

On the evening of the day on which Mr. William Wilson retired from the position of superintendent of machinery of the Chicago & Alton, the foremen and others who had been his leading assistants made a surprise visit to his house and presented their old chief with a handsome silver water set. Although he always worked very strictly after the interests of the company, Mr. Wilson was very popular with the employés under him, high and low.

Mr. Pulaski Leeds, Master Mechanic of the Louisville shops of the Louisville & Nashville system, has been appointed to succeed Mr. Harvey Middleton, resigned, as superintendent of motive power. Mr. Leeds, who went to Louisville from the New York, New Haven & Hartford, is acknowledged to be one of the most successful shop managers in the country, and some of his labor-saving methods have been largely followed. He is succeeded by Mr. W. W. Pike, Master Mechanic of the Decatur shops.

We have to acknowledge a pleasant visit from Mr. Anselmo Moraga, a gentleman largely interested in railroad and mining property in Chili, who is on a visit to the United States for the purpose of examining machinery of different kinds with a view of making large purchases. Mr. Moraga is an experienced mechanical engineer, and interests himself warmly in the design of all kinds of railway machinery. He finds that our mining machinery is much better developed than that made in European countries, and he entertains a high opinion of the merits of American machine tools.

During the absence of Mr. R. W. Bushnell at the convention the foremen engineers and others conspired together. An evening or two after Mr. Bushnell's return a crowd of the employés waited upon him, and Mr. J. H. Burns, traveling engineer, as spokesman, said that they had become very much dissatisfied with the —— old horse that the head of their department was driving, and they brought him a steed worthy of a man who had urged a locomotive to its best pace. The horse was a very handsome animal, and Mr. Bushnell expressed himself as being highly gratified with the token of good will shown by his men.

Mr. J. E. Phelan, Master Mechanic of the Northern Pacific at Mandan, Dak., who is an occasional correspondent of the NATIONAL CAR AND LOCOMOTIVE BUILDER, has been writing a series of articles for the *Locomotive Engineer* on "Air Brake Practice," and they are about to be published in book form. Mr. Phelan was for several years traveling engineer of the Northern Pacific, when part of his work was to instruct trainmen on the brake. He mastered the subject thoroughly, and anything about air-brakes which he has not told is scarcely worth knowing. Besides being an expert on brakes, Mr. Phelan is a polished, graceful writer, and has the capability of explaining mechanical appliances in a clear fashion that is intelligible to minds not trained in the reading of mechanical descriptions.

Manual of Instruction for Locomotive Engineers and Firemen. By George H. Baker.

This is a small book convenient for the pocket, prepared by the author, who is a road foreman of engines of the Chicago, Burlington & Quincy Railroad. It contains in very readable form a great deal of the kind of information that all enginemen must possess if they are to perform their duties efficiently. The work is essentially practical, by a highly intelligent practical engineer of studious and observant habits; but it also contains numerous clear explanations of the philosophy of good locomotive management. The instructions are given under five divisions, which consist of source of power, combustion of coal and firing, formation of steam and boiler feeding, use of steam, friction and lubrication. We very cordially commend the book to all persons interested in the economical running of locomotives. It is for sale by the author, whose address is Aurora, Ill.

Newest Style of Dining Car.

A fine new dining car has just been built for the company in the Grand Trunk shops at London, Ont., under the supervision of Mr. J. D. McIlwain, superintendent of the shops. A local paper has the following to say about the car:

It was planned and designed at the car works by the superintendent and built under his direction, and is a credit to the works and workmen. It combines all the new ideas in modern dining car service, including some original with the Grand Trunk. The length of the car is 63 feet, including a vestibule at each end, dining-room, pantry, kitchen, lavatory, wine-lockers and sideboards. The sideboard for glassware and silver plate, which is at one end of the dining-room, makes a very pretty effect. The interior is finished in mahogany throughout. The ceiling is of light wood veneer, ornamented in blue and gold, which gives a very harmonious effect. The floors are of cherry and maple, the center being covered with Wilton. The drapery used as window shades, lambrequins and portieres is in woollen and silk combinations made expressly for the G. T. R. The most noticeable feature is the arrangement of tables and seats, which is an innovation. On one side of the dining-room the tables are for four persons each. On the opposite side they are for two persons. Instead of the stationary or tilting seats rattan chairs are furnished, which are decidedly more convenient and comfortable than the old plan. The ventilation has not been overlooked, but has been improved. In addition to the roof sash being made to open there are fourteen acme ventilators over the lamps, which carry off the odor and heat from the lamps when lit. The lighting of the car is done by five silver-plated double acme burner lamps in the dining-room and one in each end next to the room, and on each platform is a lamp. This is certainly the best lighted car in Canada. The exterior is painted a Tuscan red, the company's standard color, and ornamented in gold. The name "Grand Trunk" is over the windows on each side, the number "788" on the center under the windows, and the word "dining-car" on each side near the ends and on each end. The car rides on two standard six-wheeled trucks. If the trial trip is a fair sample of the ease with which the car will ride, it will be the best on the road, and that is saying a great deal.

A bad accident happened last month to a passenger train on the Norfolk & Western Railroad, and the wreck was burned through, having been set on fire by sparks dropped from the locomotive fire box. The train was lighted by the Frost dry carburetter system, and the lights were extinguished when the accident happened. When the wreck was cleared up the carburetters were all found to be intact, although the solder was melted by the fire, which furnished convincing proof that there is no danger of the carburetters bursting even under the most trying conditions.

The Chicago & Northwestern are experimenting with a smoke-preventing device which supplies air above the fire of locomotive fire boxes. The invention is thus described: "It consisted of a cast iron cylinder, six inches in diameter, extending horizontally clear across the fire box, about six inches above the grate bars, and immediately in front of and below the boilers. In the cylinder are two rows of apertures, about three inches long and half an inch wide. The cylinder itself is divided in the middle by a solid partition. At each end of this arrangement is an opening through the wall of the fire box into which a steam jet forces air from without, and the air playing on the bed of coals through the slits in the cylinder induces an almost perfect combustion and consumes all the volatile gases and carbon which ordinarily escape in the form of smoke. Air is thus fed to the coal at the rate of 1,079 cubic feet per minute, and in the same time but a little over eleven cubic feet of the steam is used." The railroad company named are reputed to be contemplating putting this smoke-preventing apparatus on all their locomotives. We have seen other smoke-preventing appliances used on the same road with very little profit or satisfaction. If a little more attention were devoted to the firemen we believe there would be less necessity for smoke-preventing appliances.



A RADICAL IMPROVEMENT IN SAWS.

Among recent important inventions, none is worthier the attention of the manufacturer or the mechanic than the new B. M. T. patent tooth saw, manufactured by the Montague-Woodrough Saw Company, Chicago, Ill., which is represented in the accompanying illustration. As shown in the cut, the teeth are arranged in sets of three each, and after each set is a recess or gullet for the reception of the sawdust liberated. There are two distinct kinds of teeth in each set, two cutting teeth and one clearing tooth. The cutting teeth are made with the cutting edge on the outer edge of each tooth, and are arranged in step form, with a rise from the body of the saw of about 45 degrees. The cutting edge is on opposite sides in each pair of teeth, so that the bevels face each other, thus making two parallel gashes in the wood. The purpose of the clearing tooth, which is slightly below the points of the cutting teeth, and which is formed like a common mortising chisel, with its cutting edge at a right angle to the gash, is to clear away the wood between the two gashes into the recess or gullet before it, thus leaving the next pair of cutting teeth free from obstruction to their work. On drawing the saw back into the gash the sawdust is pushed out of the gullet, leaving it clear for the next stroke. The sharp chisel edge of the cutting teeth leaves the sides of the wood as smooth as though planed, and as little set is required, the saving of material is very great, while the absence of roughness and loose fibers lessens the friction, enabling the saw to work successfully with much less power than the V-tooth saw. With this construction the same saw will cross cut, rip or cut a miter faster and better than any one saw now made specially for either of these purposes. The same principle applies to power and all other saws. Those who have used this form of saw testify that for ease and rapidity in cutting it is an extraordinary improvement over the common saw.

Some interesting tests of the Van Dorston and Standard car couplers were made at Saratoga during the time of the Master Car-Builders' convention, and were witnessed by many interested spectators. The aim of the tests was to show how successfully the couplers worked on curves and under difficult circumstances and the performance in every instance was highly satisfactory.

Mr. George S. Morison, civil engineer, has removed his Chicago office from 205 La Salle street to The Rookery, room 1,120. His New York office remains at 35 Wall street, as heretofore.

Mr. T. M. Butterby has been appointed master mechanic of the Wabash Western in place of Mr. A. W. Quackenbush, who resigned to go to the Chicago & Alton. Mr. Butterby has been for several years traveling engineer of the Wabash Western.

Mann's adjustable side bearing for cars, which was exhibited at the late conventions, is one of those small improvements which often effect great good, and it deserves the attention of master car-builders. As is well known, nearly all cars when loaded ride on the side bearings and that often leads to the cutting of flanges beside materially increasing train resistance on curves. The Mann side bearings are adjustable, and can by the turn of a wrench be lowered to suit the height of the car body above the truck. The address of the company handling the device is Mills Building, New York.

A certain Paul Pry named John Livingston, who calls himself president of the Railway Shareholders' Association, a paper organization originated for the personal glorification of certain busybodies, has sent a complaint to the Inter-State Commerce Commission against a great many railroad companies for carrying locomotive engineers and their wives to a convention held at Richmond last year.

British fathers and public writers have been for years striving to find practical and satisfactory answers to the question, What are we going to do with our sons? The *Saturday Review* has changed the question slightly, and discussed the problem, What are we going to do with our gentlemen? As America is already suffering with an oversupply of young men, who consider themselves too genteel to don a mechanic's garb, the advice of our English contemporary would do them good if properly taken. The article concludes: It is a false idea of the "gentility" of the professional occupations that has caused the inordinate rush to them, just as a still more ridiculous ambition makes thousands of men endure an existence of dandified starvation as clerks rather than be well-fed mechanics and have grimy hands. Take away the artificial distinctions that create the spirit of caste in callings, and immediately our gentlemen have abundant employment and to spare. A movement in this direction is already apparent. Many of our nobility have been compelled by the impoverishment of the family inheritance to come down into the market place, and even ladies of title and fashion have resorted to the ancient expedient of the shop. The step does them honor. It is the man that makes the calling, not the calling that makes the man; and if only this simple old adage were more commonly remembered, there would be no cause to dread the increase of our gentlemen, but the reverse.

The New York Steam Heating Company have adopted the Magnolia Anti-friction metal for the bearings of their fast running machinery, and report it to be the best that they have ever used. This metal has also been employed for the main bearings of the Central of New Jersey Railroad's large new steamer "Sandy Hook," and this company say that they had no relief from hot bearings till they tried the Magnolia metal.

The American Continuous Draw-Bar Company, of which Mr. J. P. Coulter is President, report a rapidly increasing business, and a highly satisfactory demand among railroad companies for the continuous draw-bar. Among the railroad companies that have lately applied this excellent draw-bar to their cars are the St. Louis, Bellville & Southern Illinois, which have put it on 200 cars; the Louisville, New Orleans & Texas, which have put it on 300 cars; the Baltimore & Ohio, and the St. Louis & Kansas City. The International Equipment Company have also put it on a lot of cars.

The New York, Susquehanna & Western have just contracted for the construction of 500 new freight cars.

In our list of exhibits that were shown at the conventions we inadvertently omitted that of the Boies Steel Wheel Company, of Scranton, Pa., which deservedly attracted a great deal of attention.

Mr. Joshua Rose, writing from the Paris exhibition, says in one of his interesting letters: A large amount of emery grinding machinery is shown, all embodying items of construction of distinctly American origin, with a variation of details. Of a great many of these it may be justly said that the parts that are new are not good, and the parts that are good are not new. The French show a great deal of emery grinding machinery, and, taken as a whole, it is very creditable indeed—much of it of the very first order and original. The Tanite emery wheel (Stroudsburg, Pa.) is a great favorite here.

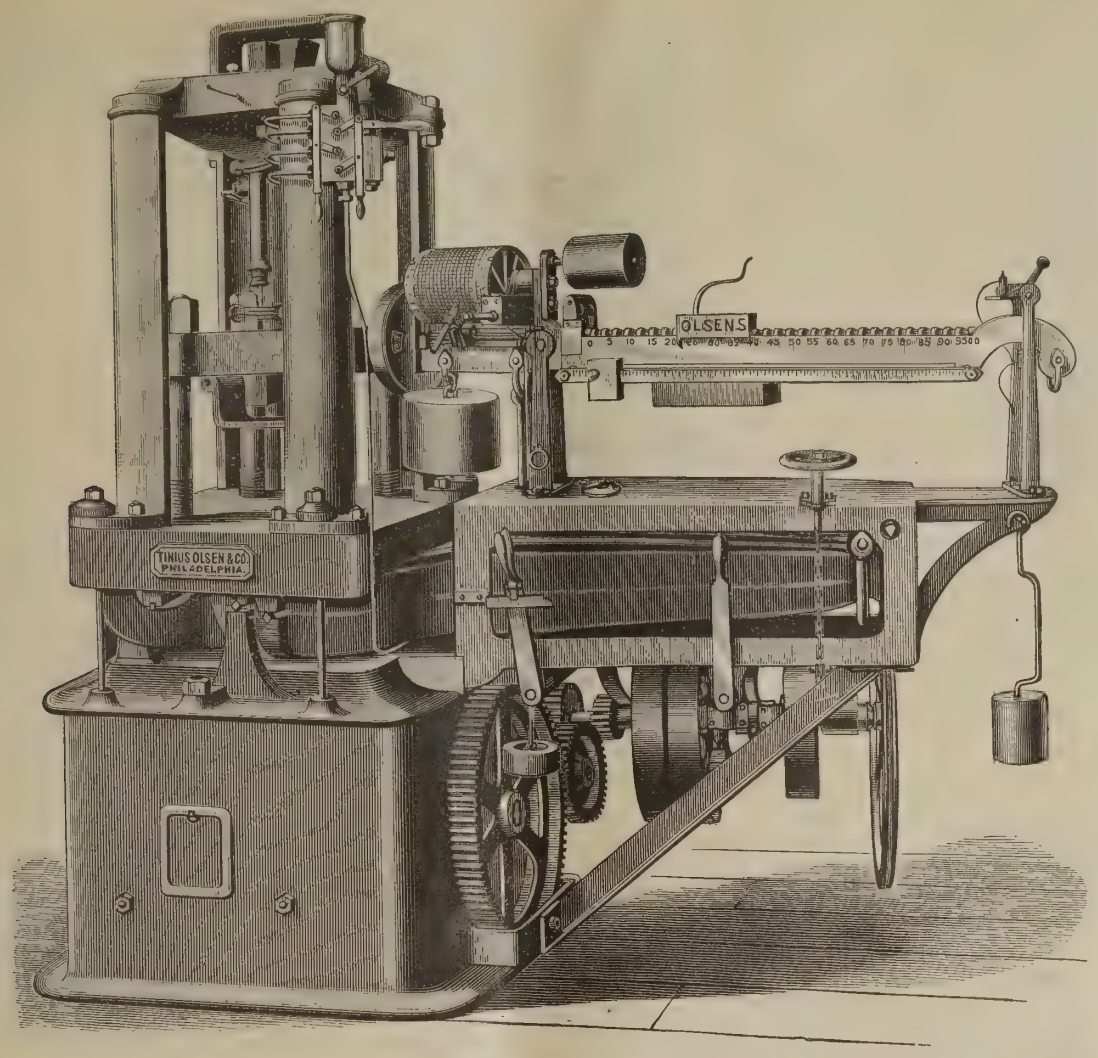
A successful experiment, valuable to the mining community, was made lately at the laboratory of the Joseph Dixon Crucible Company, of Jersey City, N. J. A piece of iron was used, ten inches long, two inches wide and one-sixteenth of an inch thick. One-half of its surface was painted with Dixon's Silica Graphite Paint, the other was half unpainted. It was then suspended for several days in a bath of dilute sulphuric acid. The acid bath was much stronger than any sulphur water met with in mining. Taking the iron from the bath, the unpainted part was found eaten off to about one-half its original bulk. The painted part did not sustain even the slightest blemish. This proves conclusively the ability of this paint to withstand sulphuric acid, and demonstrates its usefulness, particularly in mining, where iron piping is laid in sulphur water.

One of the latest productions of Darling, Brown & Sharp in the line of instruments of precision is a center gauge and gauge for grinding and setting screw tools. It is a remarkably neat little tool and ought to be in every machinist's drawer. There is no reason why any progressive machinist should go without it, for its sold for the modest price of 25 cents.

The Glidden & Joy Varnish Co., have issued a new catalogue and price list which enumerates the various qualities of varnish manufactured by the company, and quotes the latest prices. In submitting their prices the company say: In the manufacture of our varnishes, we use only the very best materials and ingredients to be obtained, and by direct importation of many of them, we are confident of their purity and excellence. This, in connection with long experience and skill in manufacturing, is a sufficient guarantee of the superior quality of our productions. The quality of our goods is attested by the fact that the demand for them has increased to such an extent as to require another large increase of our manufacturing facilities.

In publishing illustrations of Fay wood-working machinery shown at the Paris Exposition, *Engineering* says: One of the best, if not actually the best, displays of wood-working machinery in the Machinery Hall, on the Champ de Mars, is the large collection by Messrs. Fay & Co., of Cincinnati, who exhibit about twenty different machines for various purposes, and all representing their latest and best practice. The whole of these machines are driven by underground shafting from a Sweet straight-line engine, that also forms a part of the installation.

The Bell's Gap Railroad Company are using the Smith Triple Exhaust pipe, which is designed on the principle of the exhaust ejector. The general superintendent of the road, writing about the device, says: We have been using the pipe on our freight consolidation engine No. 14 during the past three weeks, and the performance of the engine has been very satisfactory. We find from actual tests, that in addition to the advantages obtained from the device, in the prevention of back pressure and the engine from throwing sparks and the noiseless exhaust, that a saving of about 10 per cent. in fuel has been made. We have found the addition of the device to the engine increases its steaming qualities considerably. The comparative test made to ascertain the saving of fuel was with engine No. 18, being of the same type as engine No. 14, with the same mileage and the same weight of train.



OLSEN'S AUTOMATIC TESTING MACHINE.

In the illustration is represented the latest and most improved form of the Olsen testing machine, as built by Tinius Olsen & Co., Philadelphia, Pa., and which is provided with many new and valuable features, lately put upon the market by them.

The essential devices for a testing machine in its function for testing a sample of material is its straining mechanism and weighing apparatus, as well as its tools for holding the sample; also in other devices, as the mode of recording the stress and determining the influence of same on the sample operated on. This makes the machine more or less able to fill the requirements of a first-class testing machine of to-day.

Taking a sample of material for tensile test to a machine as illustrated, it is secured by proper tools, one end of same to the extreme upper plate of the machine, the lower end to the plate immediately below it, exposing that part of the specimen between them on which the strain is to be exerted.

The lower plate, or crosshead, is secured to four straining screws, which pass through holes at the corners of the weighing platform of the machine through openings in the levers and bedplate, and enter the driving nuts situated below the latter; feathers, fitting into longitudinal slots cut through the threads of the screws, prevent them from turning; they, therefore, either rise or fall, carrying the lower plate with them as the nuts are rotated. These nuts are through bevel gearing operated by outside spur gearing and countershaft, which is readily observed at the lower right of the cut.

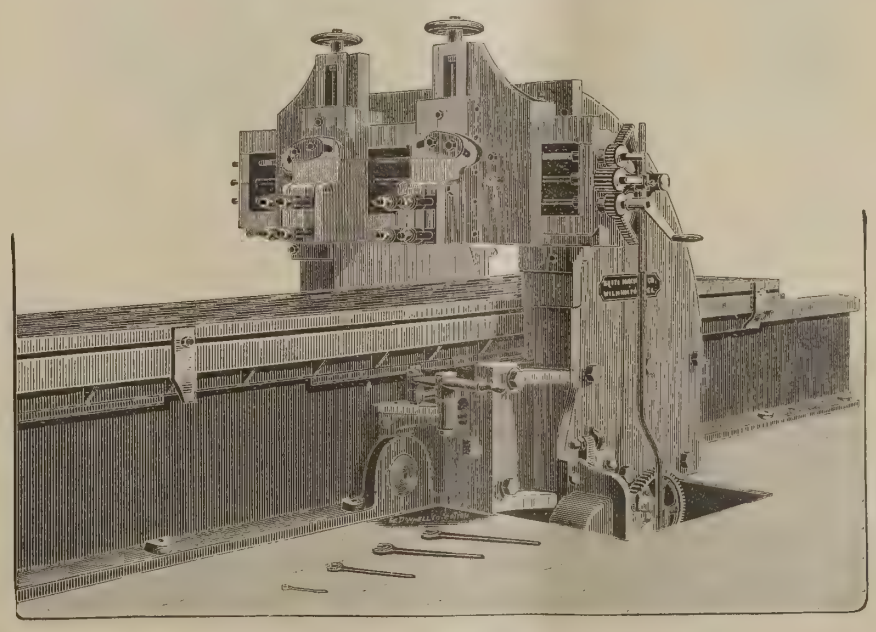
For tensile tests the ends of the specimen are secured to the plates by steel wedges, which enter rectangular openings cut through the centers of the plates; interposed in the space between the wedges proper and the plate are spherical surface bearings by which the wedges are adjusted to the specimen, and the specimen is adjusted centrally and on a parallel line to the line of greatest stress, and a straight pull secured. This item is especially imparted on cast iron and plate specimens of wrought iron or steel. The weighing apparatus consists of the main lever upon which the platform sets, three in number, but so constructed as to act as a single lever, and supporting the platform upon which rests the columns which carry the upper plate or crosshead; as one end of the specimen is secured in the upper crosshead, any stress imparted to the specimen by the lower straining head will be communicated through the columns and platform to the levers; the stress on the main lever is through an intermediate lever communicated to the beam, where the amount is balanced and thus registered.

The stresses are in this machine automatically balanced on the beam; this is accomplished by a coarse thread screw being placed on the top of the beam, the sliding weight being moved by this screw. At the end of the screw, and also extreme end of beam nearest machine, is secured a wheel by which the screw is operated. A small friction pinion is fitted into a groove in this wheel; the pinion is continually running and driven by a belt from the countershaft. In order to make connection between the pinion and the wheel, the pinion-shaft bearing is mounted on one end of a lever, the other end controlled by an electro-magnet; the electric circuit around same from a cell being connected, or *vice versa*, by the vibration of the beam; thus the raising of the beam makes electric connection, charges the electro-magnet, which attracts the lever, thus throwing the friction pinion in contact with the wheel, and the screw revolves and poise moves out. When beam drops electric contact stops and motion of poise stops.

The wheel at the end of the screw, besides operating the screw, also serves the function of a dial vernier for reading the smaller fraction of the stresses. In addition to the above described automatic motion, this machine is also provided with means by which the machine itself will record graphically the result of the test.

The Chicago & Northwestern Railroad, at Chicago, Ill.; the Southern Pacific Railroad, at Sacramento, Cal.; Mr. Henry Warden, of Philadelphia, Pa., and the Missouri University, of Columbia, Mo., are now provided with machines of this description.

The cut shown herewith is that of a special machine for planing wrought iron and steel when heavy duty is required. The machine is made in two styles and two sizes. The style shown is that known as the "low upright" machine, and will take in work 42 inches wide by 12 inches high; a similar machine is also made to take work 36 inches wide by 12 inches high. The other style is known as the "high upright" machine, and will take work 42 inches wide by 36 inches high; a similar machine is also made to take work 36 inches wide by 36 inches high. The design of these machines exhibits some novel features. The first impression is that of massiveness, which is well borne out by the absence of all ornamentation and by large smooth surfaces. The machine is characterized by simplicity in construction and accessibility for repairs. All fast-running parts are bushed with brass, and the whole is intended to withstand rough usage and heavy duty. The bed rests directly on the foundation, is deep and of heavy section, strengthened in the center and not cut to allow gearing to clear. Its length in regard to the table is ample. The top or ways of the bed are somewhat of a departure, being flat on the top and sides instead of the usual V shape. The bed is braced with numerous cross girts of heavy section, and the gearing is so placed that there is no necessity to move the bed for any repairs. The table is extra wide and heavy, and is *gibbed* down; this, together with the flat ways makes it impossible to raise the table.



A NEW SPECIAL PLANING MACHINE.

The flat ways are adopted with the belief that the best way to take the thrust of the tool is on a flat surface. In addition to this the pressure of the tool keeps the table down even on side cuts, which is just the opposite of the case of a machine with V's. The gearing and pulleys are ample for an ordinary 7-feet wide planer, and have at a convenient point a "breaking-pin," which shears off before the gears can be broken; this pin can be replaced in a few minutes and at a trifling cost, and still allows a machine to be pushed to its utmost without damage. The driving shafts are of steel and of large diameter; the length between gears and pulleys is very short, thus reducing torsion to a minimum. The pulleys are proportioned to return the table at five times the cutting speed. The "stops or dogs" for reversing the motion do not project beyond the edge of the table, which prevents catching or striking the operator. The table can be easily reversed at any time by a single motion of a convenient lever, or it may be entirely stopped without stopping the countershaft. The belts are transferred one at a time and are locked at all times. The uprights are of box form, with a very wide face; they extend down the entire depth of the bed, and are securely keyed and bolted thereto. The crosshead is very heavy and carries two saddles, which are made right and left in order to bring the tools close together; the apron holders are made the same way. The saddles and tool slides are provided with hand feeds and with automatic feeds independently reversible, or can be thrown out of gear entirely at any time. All wearing parts are provided with large surfaces and with means of compensation for wear; screws are of large diameter, and the whole machine is intended to withstand rough handling and hard work. The workmanship is first class and accuracy is nowhere sacrificed by the builders, Betts Machine Co., Wilmington, Del.

The Manhattan Railway Company have ordered a set of driving-boxes for a locomotive made of the so-called "anti-friction metal," which is a copper capable of being hardened like steel. The process of hardening, which is a secret, greatly increases the tensile strength and stiffness of the metal, and makes it an admirable material for parts of machinery which must combine great strength and lightness. Bearings of this metal that have been used under railroad cars have shown wonderful durability, combined with an anti-frictional tendency. It is used largely for bearings of electric plant, and the demand for it for such purposes is rapidly increasing.

The mechanical and technical papers of England, France and Germany are illustrating the late improved machines of the Egan Company of Cincinnati, Ohio, giving full and complete descriptions of the same, that their readers may learn of the progress being made in this country in wood-working machinery. The mechanical engineers of these countries recognize the tools of this company to be of fine design, ingenuity and simplicity for rapid and perfect work, and their foreign trade is now largely on the increase.

The Gould Manufacturing Company, Barclay street, New York, have sent out a very handsomely illustrated catalogue of the articles made or handled by the firm. It embraces an immense variety of appliances used by railroad men, especially in the line of water-working machinery. Parties requiring to purchase pumps of any description, or anything connected with them should send for the Gould catalogue, which will be found a convenient medium of reference.

Mr. J. H. Reynolds, Troy, N. Y., is manufacturing Arnold's retardation indicator, a device invented for gauging the measure of resistance exerted by the air brakes to stop a train. Its service in the handling of brakes seems to us about equal to the value of a steam-gauge in regulating the pressure of a boiler. Those who have used it speak highly of its value as a means of smooth tracking, and for the prevention of wheel sliding.

Mr. H. T. Sackett, Fond du Lac, Wis., has invented an improvement in car heaters which consists of a strong casing for an ordinary car stove and devices intended to prevent the scattering of fire in case of a wreck. There is also an attachment in the form of a glass vessel filled with chemicals that would extinguish the fire.

The Buffalo Forge Company are meeting with encouraging success in the application of their steam hot-blast apparatus for the warming of shops.

The Baldwin Locomotive Works are replacing two of their Buckeye engines with a Westinghouse compound engine of 100 H. P. This company has subdivided its power, and now has 11 Westinghouse engines, aggregating 854 H. P., in different parts of its extensive works. The Westinghouse Company are also replacing a 100 H. P. Ball engine, at the Binghamton Electric Light Company, with a compound engine.

THE STURTEVANT IMPROVED STEAM HOT-BLAST APPARATUS FOR HEATING AND VENTILATING.

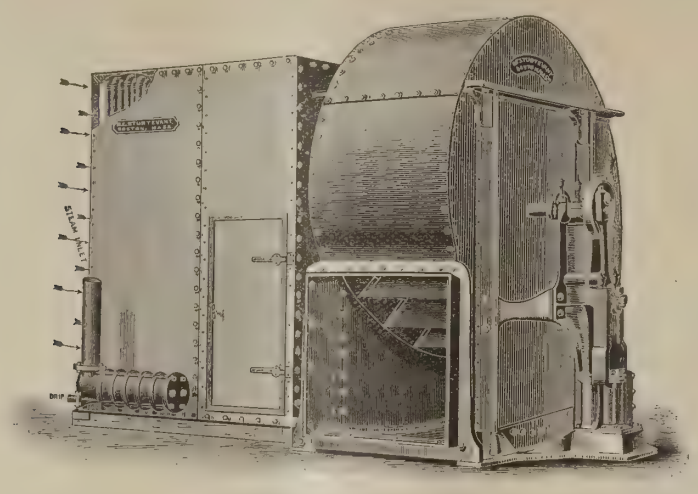


Fig. 1.

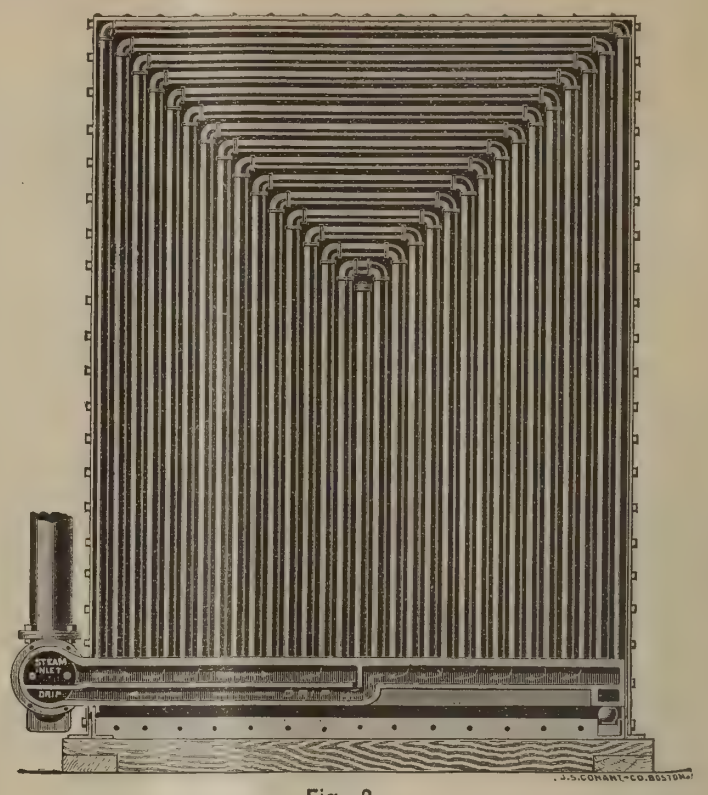


Fig. 2.

B. F. Sturtevant, Boston, Mass., has just brought out an entirely new design of his steam hot-blast apparatus, which is now so well known.

This apparatus, first placed upon the market a quarter of a century ago, has been gradually improved and rapidly introduced, until about 5,500 are now in use for various purposes.

The apparatus is a practical embodiment of the principle that a positive circulation of air is necessary to secure rapid and perfect ventilation, heating or drying.

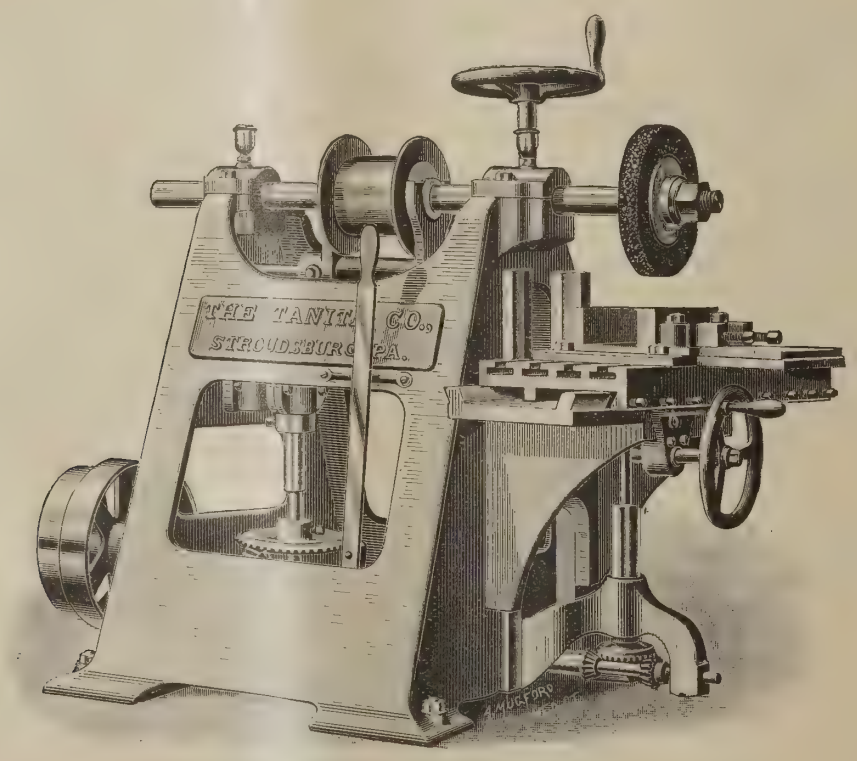
The Sturtevant apparatus, although constructed in a great variety of styles, to suit all conditions and requirements, always combines the essential elements, a fan and a heater. It is, furthermore, usually constructed with an engine directly connected to the fan shaft, as shown in Fig. 1.

The fan is designed especially for handling large volumes of air with a minimum expenditure of power, and is constructed almost entirely of steel. The shell and wheel are of steel plate, and the shaft of steel, while all stays and braces are of angle or deck iron.

Radical changes have been recently made in the heater which forms a very important factor in the combination. As now constructed the heater proper consists of a series of hollow sectional bases shown clearly in Fig. 2. Their sides are corrugated so as to fit closely together and allow of no alternate expansion and contraction of the air passing between the pipes. At one end of each section is a circular head (see Fig. 2) divided horizontally by a diaphragm, so that the upper portion is in communication with the steam inlet and the lower with the drip. Steam admitted at the left through the steam inlet passes up the series of pipes through the horizontal pipes and down into the space connecting with the drips. By this time it has condensed, and leaves the heater in the form of water of condensation.

Most assuredly the system is worthy of investigation by any one requiring either heat or ventilation. It is now in use in some of the largest manufactories in the country, such as the Pacific Mills, Lawrence, Mass.; the New O. N. T. Clark Thread Mill at Kearney, N. J.; the Morgan Engineering Company, Alliance, Ohio; Niles Tool Works, Hamilton, Ohio, etc.

Mr. Sturtevant has recently issued a handsome 80-page illustrated Treatise on Ventilation and Heating, which we are informed will be sent to any one requesting it.



NEWMAN EMERY PLANER.

We illustrate herewith the Newman emery planer specially designed for grinding flat surfaces rapidly. In this machine the emery wheel revolves at a surface speed of about 5,500 feet per minute, while it has a to and fro or traverse motion across the work, which latter is at the same time fed under it by the usual devices of a planer bed. The result of this compound motion is that the emery wheel cuts with great freedom and rapidity. We have seen it, on a very extreme trial, take a cut $\frac{1}{4}$ of an inch deep; and, also as an extreme of work, it has been made to take a cut of $\frac{1}{16}$ inch deep over a surface of 100 square inches in 6 minutes and 9 seconds. The ordinary cut is $\frac{1}{64}$ to $\frac{1}{32}$ inch. These machines can be used on any flat surface, and are specially valuable for grinding chilled dies, such as are used for nuts, etc.

Our cut illustrates the latest form of this machine. The form here shown has the frame in one solid casting. It stands much lower than the old one did—has a much wider base, and so stands much more solidly. The sole manufacturers of this machine are The Tanite Company, of Stroudsburg, Monroe County, Pa.

The demand for the automatic compound engine recently placed on the market by the Westinghouse Machine Company is such that the company is actually selling entire shop orders of different sizes before their manufacture is even commenced. Up to the present time they have built and sold seven different sizes of these compound engines, ranging from 35 to 150-H. P. They have also been compelled to add two additional sizes (viz. 200 and 250-H. P.) to their list, and are now working their pattern and foundry departments day and night, in order to get the first shop orders completed promptly. Already, they have actual orders for12 of the 200-H. P. size and several orders for the 250-H. P. Among recent orders for compound engines were the following: One 35-H. P., three 50-H. P., five 65-H. P., two 100-H. P., one 125-H. P., seven 150-H. P., seven 200-H. P., one 250-H. P.; total 27 engines, aggregating 3,535 H. P.

The Dunham Manufacturing Company report that the Northern Pacific Railroad has recently placed orders with them for Servis railroad tie-plate and 1,500 sets equipment Dunham storm-proof freight car door. Missouri Pacific 500 sets equipment, and a number of smaller orders for various roads. The Rio Grande & Western has ordered 200,000 plates, or sufficient for 40 miles of track.

Our Directory.

We note the following changes since our last issue. Our readers will do us a great favor by giving us prompt notice of any changes that may come to their knowledge or of any error that may be noticed in our list.

Atchison, Topeka & Santa Fé.—George Hackney having resigned. Harvey Middleton has been appointed superintendent of machinery of the Atchison, Topeka & Santa Fé and the Chicago, Kansas & Western, with headquarters at Topeka, Kan.

Baltimore & Ohio.—Alfred Walter has been made general uperintendent of the system east of the Ohio River.

Carolina Central.—L. C. Jones, superintendent, died July 10. T. W. Whisnant has been appointed superintendent, with office in Wilmington, N. C., to succeed the late Col. L. C. Jones.

Chautauqua Lake.—J. Murray Africa has been appointed general manager in place of P. G. Jewett, resigned.

Chicago & Northwestern.—E. E. Hughes has been appointed acting superintendent of the Middle Iowa Division, vice H. C. Manhanna, resigned.

Chicago & West Michigan.—W. L. Morris has been appointed superintendent of motive power.

Cincinnati, Hamilton & Dayton.—Charles Waldo has been apponted purchasing agent.

Covington & Macon.—A. J. McEvoy, superintendent, has resigned.

Denver, Texas & Gulf.—Frank W. Morse, master mechanic, has resigned.

Duluth & Iron Range.—S. T. Pope, who has been superintendent, has been appointed general superintendent.

Fort Wayne, Cincinnati & Louisville.—George W. Saul has been appointed general manager.

Fremont, Elkhorn & Missouri Valley.—P. C. Hughes has been appointed general superintendent. E. T. Horne has been appointed superintendent of the Sioux City & Pacific, with headquarters at Fremont, Neb.

Houston & Texas Central.—G. A. Quinlan has been appointed general superintendent, taking the place of A. H. Swanson, transportation manager.

Jacksonville & Southeastern.—D. W. Rider has been appointed superintendent, with headquarters at Jacksonville, Ill.

Louisville & Nashville.—Pulaski Leeds has been appointed superintendent of machinery, vice Harvey Middleton, resigned.

Louisville, New Orleans & Texas.—T. J. Nicholl has been appointed general superintendent.

Mexican National.—J. N. Galbraith has been appointed super intendent of the Northern Division, with headquarters at Laredo, Tex.

Missouri Pacific.—Frank Stillwell has been appointed acting superintendent of the St. Louis terminals, in place of E. G. Thompson, deceased.

New York, Lake Erie & Western.—W. M. Derr has been made assistant superintendent of the Susquehanna division, in special charge of the Jefferson branch, with office at Carbondale, Pa. C. A. Brunn has been appointed superintendent of the Buffalo division. John S. Matson has been appointed superintendent of the Eastern division of the New York, Pennsylvania & Ohio.

Orange Belt.—Frank E. Bond has been appointed superintendent. R. B. Foss has been appointed master of transportation.

Pittsburgh & Western.—J. H. Agnew, master mechanic, has resigned.

St. Paul & Duluth.—A. J. Callahan has resigned as purchasing agent and W. N. Schaff has been appointed assistant purchasing agent in charge of that department.

Southern Pacific.—C. W. Wallace has been appointed master mechanic of the Visalia division of the Southern Pacific, vice Mr. H. Stillman, resigned.

Wabash.—Frank Morse has been appointed master mechanic, with headquarters in Fort Wayne, Ind.

Wabash Western.—T. E. Butterly has been appointed master mechanic.

Wheeling & Lake Erie.—A. G. Blair has been appointed traffic manager; W. R. Woodford has been appointed general superintendent.

Employment.

WANTED.—A Master Mechanic on a small railway would like to improve his position. Capable and experienced in designing, building and maintenance of locomotives and shops. Address "M," office NATIONAL CAR AND LOCOMOTIVE BUILDER.

NATIONAL CAR AND LOCOMOTIVE BUILDER

SEPTEMBER, 1889.

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The Wisconsin Central line lost four locomotives last month by the burning of a new round-house at Ashland, Wis.

The Lafayette Car Works, of Lafayette, Ind., have recently been awarded contracts for 500 box cars by the Pennsylvania, and for 100 furniture cars by the Northern Pacific.

The Toledo, St. Louis & Kansas City road, having been made standard gauge, has 600 freight cars, 11 passenger cars and 11 locomotives of narrow gauge width which it offers for sale.

The Carlisle Manufacturing Company, of Carlisle, Pa., has contracts on hand for 100 cars for export to Cienfuegos, Cuba; 200 coal cars for the Pennsylvania, and a quantity of mining cars for various parties.

The South Australian Railway Commissioners have decided to adopt the Westinghouse automatic brake on the broad gauge, and the automatic vacuum brake on the narrow gauge lines in the Colony.

The San Francisco and North Pacific will soon place an order for 25 box cars and 50 platform cars. These cars may be built at Tiburon, Cal., opposite San Francisco, where the company recently had 50 box and platform cars built.

The Chicago, St. Paul & Kansas City will expend $250,000 in building in St. Joseph, Mo., by next spring. Additions to the present buildings will be made, and extensive shops will be constructed. The general machine and repair shops of the company are to be located in St. Joseph.

The Harrisburg Car Manufacturing Company, of Harrisburg, Pa., has recently taken the following orders: 200 box cars and 100 gondolas for the Iron Car Company, of New York; 200 hopper-bottom gondolas for the Pennsylvania, and 400 oil-tank cars for private lines.

The Canadian Pacific have decided to erect a new station and extensive repair shops at London, Ont., for the division between Toronto and Detroit. The city of London has pledged itself to a bonus of $25,000 on condition that the shops be erected there.

The Kansas City Car & Wheel Works started up last month after several months' idleness. The company has secured the contract for building 500 refrigerator cars for the Pabst Brewing Co., of Milwaukee, to be used on the Chicago, Milwaukee & St. Paul. This contract, with others obtained also, will afford employment for 500 men for 12 months.

Some consolidation locomotives were built lately by the New York Locomotive Works according to the designs of the master mechanic of the road to which they were going. When the builders were ready to put up the side rods, it was found that the engine had to be jacked up before this could be done. Rather troublesome engines to repair, where a side rod cannot be taken down till the engine is jacked up.

For the last year or two considerable notice has been made of the Harris & Crossley patents for a new form of sleeping car. The invention consists of a combination sleeping and parlor car, so designed that the berths, when not in use, are placed in receptacles under the floor. A company has now been organized at Portland, Me., to build cars of this kind, and it is said that several cars will soon be running.

The Rio Grande Western has let contracts for 30 passenger and baggage cars to the St. Charles Car Company, of St. Charles, Mo., and for 500 stock, gondola, coal, box and flat cars with Wells & French Company, of Chicago, and the Litchfield Car Company, of Litchfield, Ill.

The only locomotive building company in America that exhibits an engine at the Paris Exhibition is H. K. Porter & Co., Pittsburgh, Pa. They have a small engine there of the type built by the firm for the Latin American Republics, and it is very favorably spoken of by engineering experts.

The Erie Car Works, of Erie, Pa., have the following contracts on hand: 100 coal cars for a New England road, 100 coal cars for the Rainey Bank, Coal and Coke Company, and 300 gondolas for the Pennsylvania. The works have a capacity of 20 cars per day, and these orders will be soon filled.

Two trains have been built consisting of one combination baggage and smoking car, two coaches, and two drawing-room cars—ten in all. The coaches and combination cars are to be the property of the "Shore Line," made up of the Old Colony, New York, Providence & Boston, and New York, New Haven & Hartford. The drawing-room cars are owned by the "Wagner Shore Line Company" and the railroad companies jointly.

The recent sale of the Otis Iron and Steel Company's works in Cleveland, O., to a syndicate composed of English capitalists, is said to have been brought about by the failing health of Mr. Otis, the founder and president of the company, making him anxious to retire from active business. Those doing business with the company are likely to experience little difference from the change of ownership, as Mr. Otis will, for the first year, be chairman of the committee of management, and Messrs. Joping and Bole, the present managing directors, have engaged to remain with the new company for five years.

The locomotive superintendent of a railway in Russia is using compound locomotives very successfully, working on long gradients where the full power has to be developed most of the time. It was accidentally discovered that engines of this kind work better when the crank connecting with the low-pressure cylinder leads than when the high-pressure crank leads. On account of this it has been determined to arrange the low-pressure crank of all the compound locomotives to lead. The conditions of railroad train operating in Russia appear to be more nearly parallel to those of the United States than those of any other country in Europe.

Professor Thomson, of electric welding fame, has just perfected an invention by which the rails of street or steam railways may be welded together by electricity after being placed in position. A dynamo propels over the tracks an electric welding machine, which welds the rails into one continuous line after it passes over them. It is proposed to have at every 100 feet a break, to allow for expansion, etc. President Whitney is reported as saying that the application of this invention to the West End system will save the country at least $15,000,000 per annum. Any kind of rails can thus be welded, and in the event of such operations in the West End lines, power can be obtained from the wires now in use, but a 500 voltage being required.—*Manufacturers' Gazette, Boston.*

The Alabama Great Southern recently placed an order for ten new cars, baggage, mail, express and passenger coaches, with the Ohio Falls Car Company, of Jeffersonville, Ind., and the cars are now being received. The Ohio & Mississippi is having seven United States mail cars, 62 feet in length, and four coaches of mahogany finish on the interior, built at these works. They have recently delivered three passenger cars to the Nashville, Chattanooga & St. Louis. The cars are handsomely finished in mahogany and red wood, and will be used on the Nashville & Chattanooga Division. These works have secured a contract to construct 500 freight cars for the Pennsylvania Company, and have sold 50 box cars to the New Orleans, Fort Jackson & Grand Island road, and 50 gondolas to the Birmingham, Sheffield & Tennessee River.

An important element in contributing to the success of the visit of the American engineering societies to Europe has been Mr. William Wiley of New York, treasurer of the American Society of Mechanical Engineers, and the official correspondent of *Engineering*. Mr. Wiley has acted as historian of the doings of the American engineers, and he has never failed to do justice to those who extended kindness and courtesies to his visiting brethren. Besides being a remarkably attractive writer, he is an eloquent and ready speaker, and his talents in this line have helped to impress upon their friends abroad the fact that the American engineers have been grateful for, and thoroughly enjoyed, the splendid hospitalities extended to them. Next to their hosts abroad Mr. Wiley deserves the sincere thanks of all American engineers.

Some discussion is going on in foreign papers concerning the priority of invention of the radial valve gear. Bremme, Strong, Marshall, *et al*, are rival claimants. These parties, it appears, use a valve gear based upon, if not identical with, Hackworth's gear of 1859, which is, it is claimed, the parent radial valve gear.

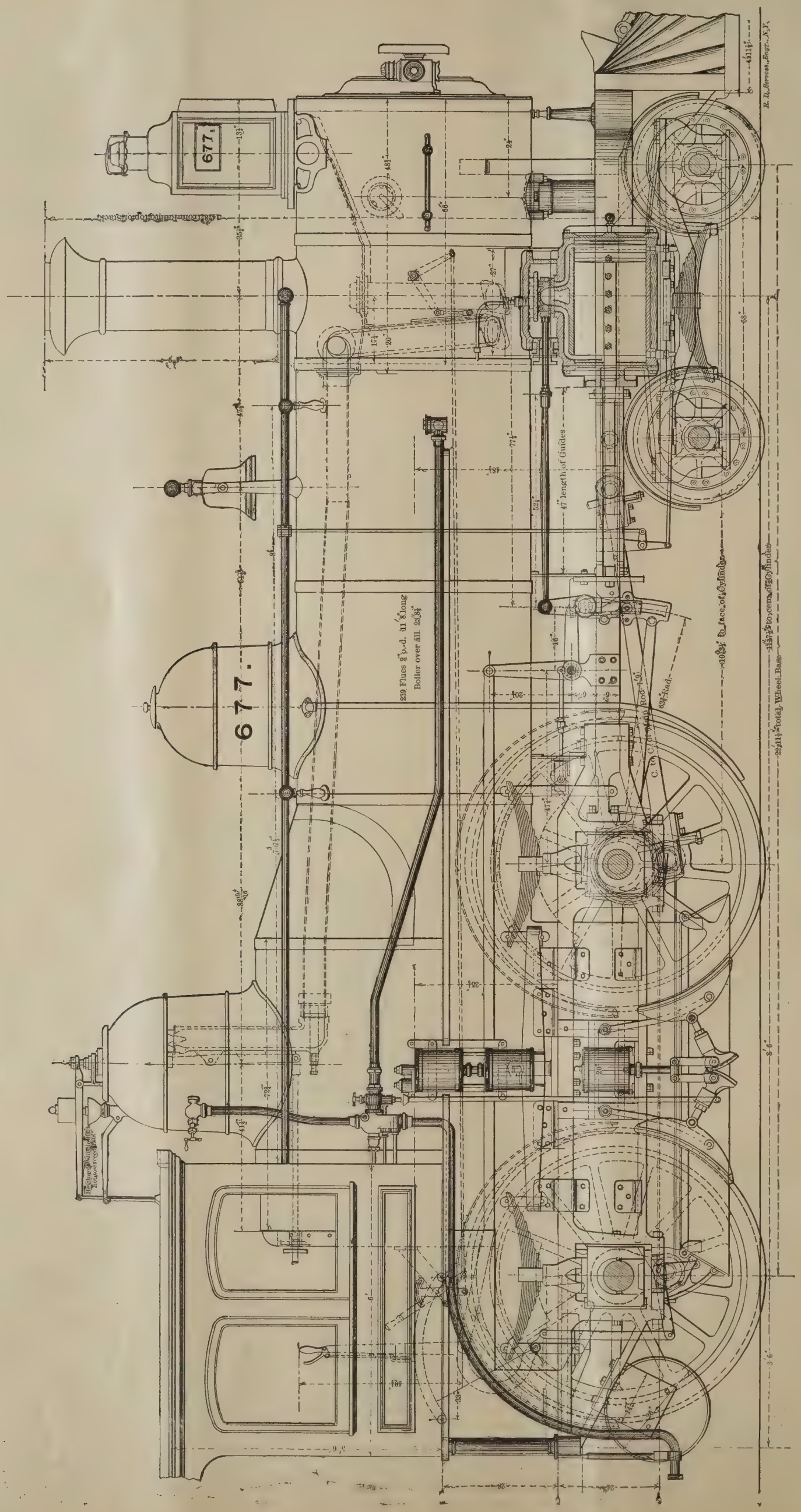
It strikes us that there is an American radial valve gear in existence which ante-dates Hackworth, or if not this in fact, it is at least coeval with it. We believe that Herman Winter's radial and rotary valve gear, as fitted to the Stevens' long-toe cut-off, was invented and applied in 1856. This is, to the best of our information and belief, the first radial valve gear put to actual sea service on a marine engine. Winter's valve gear was patented in 1856.—*Engineer.*

The South Bethlehem Car Works have completed a private car for the use of ex-Senator Henry G. Davis, president of the West Virginia Central road, which is very handsome in design and finish. The parlor or observation-room is at one end, and is furnished with sofas and large, comfortable chairs. Next to this are the state-rooms, and at the other end of the car is the kitchen, supplied with a cooking-range, with tanks, and ample dish closets. The interior of the car is finished in mahogany. the carpets and upholstery being of olive shade. The hangings are very rich and tasteful. The car is supplied with all conveniences, such as hot and cold water, electric bells, and is equipped with the Westinghouse air brake and air whistle signals, and with Janney couplers. The South Baltimore Car Works being busy on freight-car work, the car was taken to the Mount Clare shops of the Baltimore & Ohio to be fitted out.—*Railway World.*

A street roller which the Standard Foundry Company recently built for the city of Cairo, Ill., has created more commotion in that quiet and very formal old town than an unfettered Texas steer or an escaped circus tiger. The roller had evidently concluded to "take in the town" immediately on arrival at destination. Its first caper was to smash a stage plant and roll into the river. It was rescued after about half the population had been called out and nearly all the ropes and tackle in the place had been broken severally and in conjunction three or four times. Then it was ordered weighed by the mayor, but only one coal dealer in the town would agree to have it placed on his scales. They were wise, too, for the roller just dropped through the scales as easily as a window cleaner falls through a skylight. The mayor was then completely disgusted and broken-hearted, and told the city comptroller to pay for the dodgasted thing, for he was satisfied that it weighed enough. He didn't propose to bankrupt the community in further experiments.—*Age of Steel.*

The manner in which the handling of the passenger traffic on Brooklyn Bridge is operated ought to be a standing object lesson against taking the control of railroads from private companies. The bridge railway is operated by a cable system, which was constructed at very great expense, no outlay having been spared for appliances that were regarded as necessary to making the system mechanically perfect. The management of the bridge is in the hands of trustees appointed by the cities of New York and Brooklyn, and this municipal control appears to exert a blighting influence on the officers and men doing the work. While the railroad companies at each end of the bridge do an immense passenger business morning and evening without delay or annoyance to passengers, the bridge cars are constantly experiencing delays which generally prostrate the business at the hours when the greatest inconvenience can result to the greatest number. And the employés of the bridge are insufferably insolent to their masters, the public. Yet complaints appear to reach no head that can apply relief.

The new steamer "Teutonic," belonging to the White Star Line is a triumph of naval architecture, and the machinery displays in a wonderful degree the high development of engineering genius of design and skill of execution. The engines are triple expansion, with three cylinders, of 43, 68 and 110 inches diameter respectively, and 60 inches stroke of piston. The engines are built according to the Admiralty specifications, and are set entirely under the water line. The engines are designed to develop 17,000 horse-power, or a propelling effort equal to that which could be exerted by about 34 of our largest consolidation locomotives if their connecting rods could be coupled to the propeller shaft. The boilers are twelve in number. Some are 12 feet and some 12 feet 6 inches in diameter and 17 feet long, with six furnaces in each, and a grate area of 1,163 feet. The furnaces are fed with forced air to a moderate extent above the fuel and under the grate, and the boilers are designed to work up to 180 pounds. The initial pressure in the intermediate cylinder is 80 pounds, and in the low about 16 pounds, with a vacuum of 7. There are two propellers 21 feet 6 inches diameter, with a pitch of 28 feet 6 inches, and a superficial area of 128 square feet. The vessel is 582 feet long, being now the largest ship afloat, 57 feet 6 inches broad, 39 feet 4 inches deep, and has a gross capacity of 9,685 tons.


677
677.
239 Flues 2" O.d. 11' 8" long
Boiler over all 23' 3"
47" length of Guides
NEW YORK CENTRAL HIGH-SPEED LOCOMOTIVE.

Test of a High-Speed Locomotive.

BY ANGUS SINCLAIR.

The New York Central & Hudson River Railroad is the leading artery that carries the ever-moving current of passenger travel westward; the passenger trains are exceptionally heavy, and they are pulled by the representative locomotive of this continent, burning bituminous coal as fuel. These components make this a good representative railroad, and an examination and carefully prepared estimate of the mechanical work involved in operating the trains are likely to be of living interest to all men concerned in the movement of trains. Through the courtesy of Mr. William Buchanan, superintendent of motive power and rolling stock of the railroad named, the writer was privileged to take indicator diagrams on engine No. 677 while pulling the New York & Chicago limited express train between New York and Albany, that being the finish of a series of tests carried on for months to ascertain accurately the quantity of fuel and water consumed in doing the work.

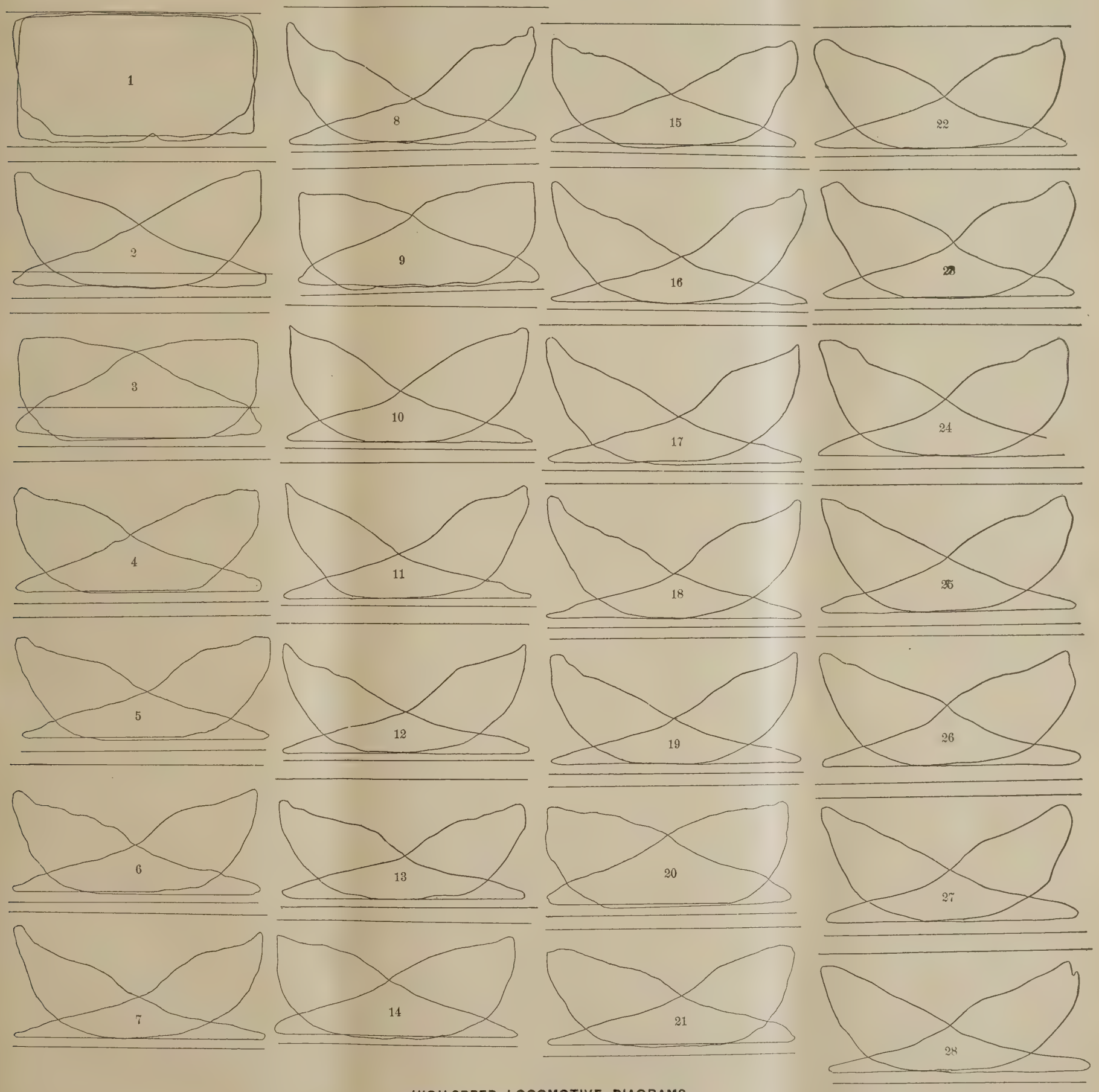
The locomotive that did the work is of the ordinary eight-wheel American type shown in the annexed engravings. The engine has cylinders 18 × 24 inches, and the driving wheels are 69.5 inches diameter. Figured by the well-known rule, the tractive force per pound of effective cylinder pressure is 112 pounds. The total weight of the engine in working order is 94,500 pounds, of which 60,000 pounds rest on the driving wheels. By the Railway Master Mechanics' Association formula this gives 4.2 as the coefficient of adhesion.

A distinguishing feature about the engine is the fire-box, which is of the Buchanan patent pattern, divided diagonally into two chambers by means of a water table, which has an oval opening in the middle, through which the gases of combustion pass from the fire into the tubes. The fire-box was also equipped with a smoke-preventing device which uses steam jets to inject currents of air upon the surface of the fire. The effect of these means toward perfect combustion and the work of a remarkably skillful fireman was that no smoke was to be seen issuing from the stack, although the coal used was rich in volatile gases. In combination with the extension smoke-box the water table fire-box makes an admirable spark arrester, for in passing through the tunnels there was scarcely anything to be seen in the shape of sparks.

The engine, which is one of a leading class employed on fast passenger service, is finely proportioned throughout, does her work with remarkably small expense for repairs, and failure in service is practically unknown, although many of the engines make extremely long mileage. Two crews are employed on engine 677, and she doubles the road between New York and Albany, 143 miles, daily, which makes about 7,000 miles a month. She rides as smoothly as a parlor car, and steams as freely, no matter how hard she may be worked.

The following are a few of the leading dimensions of the engine :

Size of cylinders	18x24	in.
Length of ports	16½	"
Width of steam ports	1¼	"
Width of exhaust ports	2⅛	"
Clearance of pistons at each end	5-16	in.
Valves, Richardson balanced		
Valves, full travel	5	"
Valves, outside lap	1	"
Valves, inside lap	1-10	"
Valves, lead in full gear	1-10	"
Valves, lead in center notch	¼	"
Radius of link	63⅜	"
Exhaust nozzles, high double	3½	"
Diameter of driving wheels	69½	"
Diameter of boiler at smallest ring	54	"
Number of 2-inch tubes	238	
Length between sheets	11 ft. 7	in.
Length of fire-box	80 3-16	"
Width of fire-box	43	"
Depth of fire-box	79¾	"
Grate area in square feet	18	
Heating surface of tubes in square feet	1,440	
Heating surface of fire-box in square feet	160	
Heating surface of total in square feet	1,600	
Weight of engine in working order	94,500	lbs.
Weight of engine on drivers	60,000	"
Weight of engine on truck	34,500	"
Capacity of tender, water	3,200	gal.
Capacity of tender, coal	12,000	lbs.



HIGH-SPEED LOCOMOTIVE DIAGRAMS.

The tender is fitted up with spout for taking water while running from a trough placed in the middle of the track.

The train consisted of seven vestibule cars, weighing, with their loads, 295½ tons. With engine and tender the total weight of the train moved was 378 tons. The regular practice with this train is to leave New York at 9.50 A. M. and arrive at Albany at 1.10 P. M., making the run, without stopping, in 3 hours and 20 minutes, being at the rate of 43 miles an hour. By following the bank of the Hudson River, the New York Central Railroad escapes from the annoyance of having to lose time by slowing up frequently for grade crossings, but, nevertheless, there are found in practice to be necessary reductions of speed that entail the increasing of the average velocity

to over fifty miles an hour in order that the end of the journey may be reached on time. On the day the indicator tests were made, the speed was reduced three times to 12 miles an hour to scoop water, it was reduced under 10 miles an hour while passing important stations, and once to 20 miles an hour to go through a town. A hot box on a car called for a stop at Hudson and caused a loss of eight minutes, which had to be made up in the last 29 miles. The time was made up, but it required some fast running, and one diagram was taken at a train speed of 65 miles an hour.

There is probably no railroad in America where the high-speed trains are kept going with so few interruptions to the fastest average as those on the New York Central, yet graphic diagrams showing the variations of speed of the Chicago limited express during the run of 143 miles would look like ten distinctly defined mountains of high speed with valleys of depression between. The train was lifted slowly into speed, and it took almost four miles for the engine to increase the speed from 10 miles an hour to 52 miles an hour. The diagram line would then move almost horizontally for perhaps 10 or 15 miles, when the necessity for reducing speed would arise, and by use of the brakes the velocity would drop 40 miles within 500 yards. Then after running perhaps a mile at the reduced speed, the engine would again laboriously work the train into the motion that the brakes had dissipated. This is a distinct characteristic of the way express trains are run on all American railroads, and indicates the difficulties that are in the way of maintaining a very high average running speed. It also offers an explanation of why more coal is used per mile-ton in running an American express train than what is consumed by the locomotives running fast trains abroad.

Those who have noted the speed made by British fast express will remember that the running speed is strikingly uniform. After the engine gets the train lifted to the speed necessary to keep time, all the effort called for is that which maintains the speed, as they will run along for hours without any diminution of motion. The heavy expenditure of energy and coal necessary to frequently force the train from a low to a high level of velocity is thus avoided.

The line of the New York Central from New York to Albany is nearly a uniform height above the water of the Hudson River. The total ascent made between the two cities is only ten feet, and on the way the departures from the level are very slight. The undulations vary from 4 feet per mile to 25 feet per mile; but they exert very little influence on the power required to handle the train, except where they happen to intervene at points where the engine is working the train into speed, when they retard or accelerate that consummation.

During the run of 143 miles 42 indicator diagrams were taken from the left-hand cylinder, and the data regarding boiler steam pressure, the position of the operating levers, and the consumption of coal and water were collected. The indicator used was an improved Tabor, with a spring on the scale of 80 pounds to the inch. A water meter and a gauge were both used for measuring the water.

It is not possible to show by a succession of diagrams how the work was done of gradually raising the train from a state of rest in the Grand Central Station, New York, to speed necessary to maintain schedule running time, because the first three miles took us through a long tunnel and amid numerous walls dotted with switch and signal connections—a portion of the track where it is not desirable to lean over the cylinder taking diagrams. Three miles out the speed was reduced to 10 miles an hour for a drawbridge. Beyond that point there are several sharp curves which materially increased the resistance of the train, and the speed of 44 miles an hour only was reached by hard working. When several miles further on it was necessary to reduce the speed to 10 miles an hour in passing Spuyten Duyvil. The diagram No. 1 was taken when the engine was starting the train away from the Grand Central station. The boiler pressure was 145 pounds per square inch, and the initial pressure on the diagrams was 128 pounds on the forward stroke and 132 pounds on the backward stroke. The principal interest that attaches to this diagram is its testimony that the steam fills the cylinder nearly close to boiler pressure at slow piston speed.

Card No. 2 indicates the work done in forcing the train into speed on the curves and slightly ascending grades between Harlem and Spuyten Duyvil. The diagram was taken at a speed of 41 miles an hour or 198 revolutions of the driving wheels. The boiler pressure was 140 pounds, and the engine was working in the fifth notch, cutting off at $8\frac{7}{8}$ inches on the forward stroke and $8\frac{13}{16}$ inches on the backward stroke. Although the throttle was only partly opened, the initial pressure was 130 pounds on the forward stroke and 132 on the return.

The cards Nos. 3, 4, 5, 6, 7 and 8 are worthy of careful study, for they give a very clear idea of the work done by the engine in accelerating the speed of the train from the reduced speed at Spuyten Duyvil up to the running speed required by the schedule. The speeds at which the diagrams were taken were 26, 44, 45, 49, 52 and 55 miles per hour respectively. In the first four diagrams the engine is evidently performing more work than that required to keep the train in motion at any of the speeds recorded. The balance of work beyond that required to maintain speed is converted into increased velocity. Diagrams 7 and 8 represent the engine working with merely sufficient effort to maintain the speed at about 50 miles an hour. There is a little acceleration of speed between the times when 7 and 8 were taken; but it was evidently due to the gravity of an undulatory part of the track, for the diagrams subsequently taken show that card No. 7 represents as near as can be estimated the power required to keep the train running at a speed of 52 miles an hour.

The average cylinder steam pressure is 43.6 pounds, the revolutions 252 per minute, and the indicated horse power developed is 649. The tractive power due to the cylinder pressure named is 4,677 pounds. Deducting 6 per cent. from this as an allowance for the friction of transmission, we would have 4,397 pounds of force exerted on the rails. As the track rises 10 miles in 143 miles, the train has to be elevated .07 of one foot in each mile. After deducting the equivalent in foot-pounds necessary to perform this work, there remains sufficient to show that a little over 11 pounds per gross ton was available for keeping the train in motion on the level track.

If the run was made throughout at the speed represented in card 7, the train would be taken through in 2 hours and 45 minutes, and the steam shown by the diagram as being used to perform the work would be 37,370 pounds. The consumption of steam per horse power per hour shown by the card is $21\frac{1}{2}$ pounds, a very economical performance. The water actually evaporated, as recorded by the measurements of tank to do the work, was 43,607 pounds, leaving a margin of 6,237 pounds to be accounted for by the larger diagrams and by the heat losses unavoidable with locomotive cylinders. The margin is only 14 per cent., which would be a small loss due to cylinder condensation alone. It is practically impossible to keep an accurate record of water taken from the tender of a locomotive, and in this case there was probably considerably more water used than was accounted for.

The quantity of water used could not, however, have been materially greater, for the quantity of fuel consumed was only 6,528 pounds, so that 6.68 pounds of water was evaporated at tender temperature, which was 62 Fahr. This would be equivalent to evaporating 7.7 pounds of water from and at 312 Fahr., and no locomotive doing the hard work this one was subjected to can exceed this much. The coal used was 45.65 pounds per train mile. One pound of coal performed the work required for moving one ton 8.28 miles.

It may be interesting to examine carefully the work done by the engine in the different miles when the speed was being accelerated and compare it with the work exerted after the train had attained the normal running speed. To work one mile, using the volume of steam at which the various diagrams were taken, the duty of the engine would be performed as follows:

	Foot pounds.
Card No. 3	41,077,000
Card No. 4	30,782,000
Card No. 5	28,336,000
Card No. 6	27,263,000
Card No. 7	24,693,000

The last card quoted is that which represents the normal running speed. The work performed per mile is less than that shown on the other cards, yet of course it is well known that one of the greatest difficulties in locomotive designing is to produce proportions that will enable the machine to maintain high speed. Diagram No. 3 represents 40 per cent. more work per mile than diagram No. 7, and the average of 3, 4, 5 and 6 is 23 per cent. higher than No. 7, but all the former cards were taken at a slower speed than the latter, and the element of time prevented them from exerting too rapid a drain upon the boiler. When this engine was running at 65 miles an hour, she did not seem beyond the capacity of the boiler to maintain the steam drawn out by the cylinders, but it can readily be seen that an engine which could maintain a mean effective cylinder pressure of 50 pounds per square inch at 60 miles would quickly show distress if called upon to keep the cylinder pressure up to 60 pounds while working at that speed.

The diagrams, from 8 to 19, inclusive, give a fair representation of the varied work done by the engine during the trip, but their average would not be a correct estimate of the work done, for the greater number of the cards were taken when the engine was working into speed after slowing down. Although it is desirable and edifying to examine cards of varied character, the cards like 8, 12 and 19 were the kind that would be taken during about three-quarters of the run to Hudson.

At the latter station, which is 29 miles from Albany, the train was stopped to cool a hot box on a car. The train then started eight minutes late. The engineer determined to make up the time, and he did so, but it resulted in hard working of the engine to attain the speed rendered necessary, and the keeping up of the velocity of 60 miles an hour demanded much more constant power than what was required for 50 miles an hour, as may be understood by an examination of the diagrams from 20 and upward.

All the diagrams are good, and represent an engine using steam to good purpose at all varieties of speed; but the high velocity cards are particularly worthy of attention. In one of the cards the piston speed is 1,248 feet per minute, yet the diagrams are in excellent form. I had never seen such a good card taken from a locomotive at that speed before. This card, No. 28, might be improved if there were a little more lead on the return stroke, or less clearance on the forward end of the cylinder. This engine demonstrates what a well-designed link motion can do in the distribution of steam at high speeds. Most locomotives, when running at high velocities, suffer from excess of compression, but this engine does not have sufficient compression to reach initial steam pressure at the beginning of the stroke. The steam line is remarkably well sustained for the size of port used.

The diagrams were taken in the ordinary working of the engine, no suggestions having been made to the engineer. He habitually ran throttling the steam to a limited extent, but on the whole the engine was well handled.

Annexed table gives leading particulars about the diagrams, which are shown:

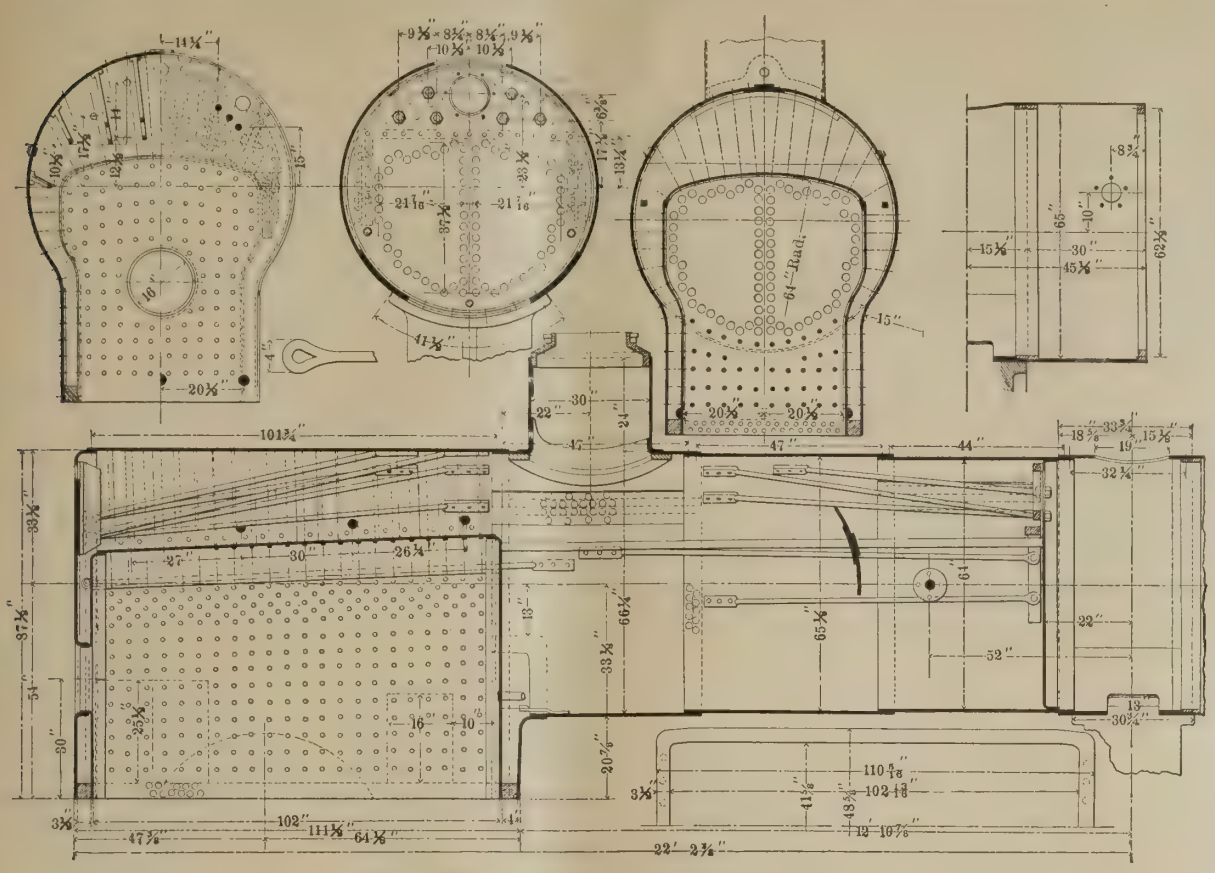
PARTICULARS OF DIAGRAMS.

No. of diagram.	Boiler pressure.	Initial cylinder pressure.		Mean effective cylinder pressure.		Revolutions per minute.	Miles per hour.	Indicated horse power.	Cut-off per cent. of stroke.
		F. stroke.	B. stroke.	F. stroke.	B. stroke.				
1...	140	125	130	120	123	Starting.	.....	.....	.....
2...	140	132	130	57.8	57.8	198	41	706	36
3...	140	114	114	72.6	70	126	26	554	41.7
4...	148	120	115	53	51.3	216	44	695	29
5...	140	120	118	48	48	222	45	657	29
6...	145	116	118	45.5	46.8	240	49	682	29
7...	140	125	120	41.8	41.8	252	52	649	29
8...	151	135	128	44.3	44.3	264	55	722	29
9...	130	107	112	59	61.5	120	25	446	41.7
10...	150	131	127	50.5	51.3	186	38.5	584	29
11...	150	130	127	41.8	45.5	228	47	613	29
12...	144	124	126	41.8	41.8	252	52	649	29
13...	135	112	108	42.9	42.9	252	52	667	36
14...	136	114	114	52.9	54.1	192	40	634	36
15...	137	121	118	49.2	49.2	228	47	692	36
16...	150	135	128	45.5	45.5	258	53.4	724	29
17...	152	137	133	45.5	45.5	252	52	707	29
18...	150	138	133	46.7	46.7	252	52	716	29
19...	140	127	122	44.3	43	252	52	678	29
20...	135	113	115	59	60.3	156	32	573	41.7
21...	135	112	115	51.3	46.8	246	51	733	36
22...	135	124	124	49.2	50.5	258	53.4	792	36
23...	145	133	134	51.3	50.5	264	55	829	36
24...	150	134	135	51.3	52.9	270	56	867	36
25...	148	134	134	49.2	51.3	282	58	873	36
26...	148	134	133	49.2	50.5	288	59.5	885	36
27...	145	133	135	49 2	49.2	300	62	910	36
28..	150	134	136	50.5	49.2	312	64.5	958	36

The latest statistics of Krupp's establishments are supplied in a book just published at Essen. In 1833 it had nine workmen; in 1848, 74. In July, 1888, it employed 20,960 men, of whom 13,626 were at Essen, and, including the families of the workmen, it supported a population of 73,799 souls, of whom 24,193 lived in the houses it provides. There are at Essen 1,195 furnaces of various constructions, 286 boilers, 92 steam hammers of 109 to 50,000 kilogs., 370 steam engines with a total of 27,000 horse power, 1,724 different machines, and 361 cranes. Of coal and coke 2,735 tons are used daily, and 11 high furnaces of the latest constructions produce nearly 600 tons of iron per day.

There are two ways of annealing steel. It can be heated to a dull red heat, covered with dry warm sand and left to cool slowly, or heat and cover up in the forge fire and leave it there until the fire is out and all is cold. The other method is to heat the steel red hot; heat gradually, let it "soak" as the smiths say, until it is evenly heated, then remove from the fire and go to some dark corner. Let the steel cool until you lose sight of the dull red in the dark, then cool off in cold water. A good "dark place" may be made by throwing your coat over a barrel, leaving just room enough to look in at the iron. This method is called the "water anneal," and is based upon the theory that steel softens when cooled at a certain temperature.

It was a Southern gentleman of a more than ordinary degree of intelligence, and on a recent visit to Chicago. He was a successful lumberman, a fact that in itself implied both sagacity and veracity. Questioned regarding cypress, he thought its good qualities but meagerly appreciated or understood either North or South. While apprehending that the stumpage is of so limited a character as to preclude its extensive use beyond the next decade if the only source of supply is to be derived from the standing timber, he said: "But, fortunately, we will not have to depend on trees now growing. Beneath the ground lies buried vast mines of timber wealth—more cypress, in fact, I believe, than is standing to-day—an accumulation possibly of centuries—logs and trees that have grown in the low, marshy swamps, and been felled by man's and nature's agencies, falling green and sinking beneath the waters of the bayous and streams, or deep into the porous soil of the swamps by reason of their heavy weight, to lie sound and uninjured until profitably uncovered in our times. These buried forests are piled up layer upon layer, in some known instances forty and fifty feet in depth. In Louisiana successful efforts are now being put forth to bring these buried forest products once more to the light of day, and a number of saw and shingle mills are cutting clear, bright building material from these selfsame logs—equally as valuable in a commercial way as the lumber from the trees just felled. It is going to prove quite an important industry, for there is a vast quantity in many localities, and the present fair prices will stimulate active operations in uncovering the logs."—*Lumber Trade Journal.*



A VERY STRONG LOCOMOTIVE BOILER.

The annexed engraving shows a remarkably strong boiler designed by Mr. D. A. Wightman, superintendent of the Pittsburgh Locomotive Works, for locomotives that are intended to carry the high pressure of steam that is becoming popular. When a boiler is made over 60 inches in diameter and is subjected to a working pressure close to 200 pounds, it requires extremely strong fastenings and perfect form to keep the sheets from becoming distorted. Mr. Wightman fully realizes this, and he has produced a boiler with the strongest natural form and fastenings, carefully proportioned to the strains to be resisted. The boiler, as will be seen by the engraving, is 64 inches diameter, and is made straight, with the dome on the first sheet in front of the fire box. This gives the opportunity to fasten the crown sheet securely to the outside shell by means of radical stay bolts, and an arched crown tends to put a direct strain on the stay bolts that bind the sheets together. The longitudinal seams are butt jointed, welted and double riveted, making the most mechanically perfect seam known. The circumferential seams are double riveted, with lap joints, and the shell of the boiler is made of first-class steel ½ inch thick. The fastenings that are put in to reinforce the flue sheets and other flat surfaces are strong and very well designed. While carrying steam at 200 pounds pressure the boiler gives a comfortable margin of safety, which a great many boilers in use do not have.

How to Use Glue.

All the glue as received from the factory requires the addition of water before it will melt properly, and every addition of water (while the glue is fresh made), will, up to a certain point, increase the adhesiveness and elasticity; and it is the duty of every man who uses glue to find out just where the point lies, as it is possible to melt glue and have it so thick that after it is dry or set it will be so brittle as not to adhere to the wood. Some glue will bear more water than others, but all will bear more than usually falls to their share, and that, too, with a greater increase in the quality of the work. For glue to be properly effective it requires to penetrate the pores of the wood, and the more a body of glue penetrates the wood the more substantial the joint will remain. Glue that takes the longest to dry is to be preferred to those that dry quickly, the slow drying glues being always the strongest, other things being equal. For general use no method gives such good results as the following: Break the glue up small, put into an iron kettle, cover the glue with water, and allow it to soak twelve hours; after soaking boil until done. Then pour it into an air-tight box; leave the cover off until cold, then cover up tight. As glue is required, cut a portion and melt in the usual way. Expose no more of the made glue to the atmosphere for any length of time than is necessary, as the atmosphere is very destructive to made glue. Never heat made glue in a pot that is subjected to the direct heat of the fire or lamp. All such methods of heating glue cannot be condemned in terms too severe. Do not use thick glue for joints or veneering. In all cases work it well into the wood in a similar manner to what painters do with paint. Glue both surfaces of your work, excepting in case of veneering. Never glue upon hot wood, or use hot cauls to veneer with, as the hot wood will absorb all the water in the glue too suddenly, and leave only a very little residue, with no adhesive power in it.—*Wagonmaker.*

English machine shops make extended use of a tool wnich is but little used in America. It is a band-saw for metals. Its construction is similar to that of a heavy band-saw, with a third carrying-wheel for the saw, the object of which is to remove the up-moving side of the blade from the vicinity of the table and thus leave a deep throat through which a large piece of work can be passed or a wide plate turned. This third wheel is placed at the back of the machine, about midway in the vertical height of the saw-blade. The temper of the saw is slightly harder than that of those used for wood. The teeth are sharpened straight across the blade by a cutter, with its teeth at the right height to suit the teeth of the saw-blade. This tool is used to cut off the spines from steel castings, the ends of bolts, to saw up steel, iron and copper plates to any form, and to rough out the jaws of eccentric rods and other forgings which would require the use of slotting-machines. It cuts as well on a circle as upon a straight line. The blade is lubricated with soap and water, and in a cut six inches long through a steel connecting-rod jaw it works freely and satisfactorily. Not infrequently circular saws of large dimensions are used for the same purpose, and, being mounted on heavy frames and fed carefully up to their work, cut off large pieces of steel, leaving a nearly smooth surface on the face of the cut.

Every few months the announcement is made as something wonderful that a highly enterprising railroad company has discovered that coke can be successfully used in the locomotives, and that fuel of that kind has great superiority over coal. The latest company to make this discovery is the Baltimore & Ohio, and the newspaper talk is that soft coal will be abandoned for coke, which has proved superior to anthracite or any other kind of fuel. The Baltimore & Ohio has not been famous of late for the heavy margin of earnings over operating expenses, and we would not advise them to do much with coke as fuel if they do not wish to fall behind faster than they have heretofore done. There is no merit whatever in adapting locomotive fire-boxes to burn coke successfully. That kind of fuel was burned in nearly all locomotives in Europe for the first twenty-five years of the railroad era, and great merit was due to the engineers who introduced the practice of coal burning among people who were very strict in prosecuting railway companies that caused a nuisance with smoke. Any American railway company that moves in the direction of coke burning in locomotives is moving backward.

It is wonderful, says an English exchange, how an art or system of manufacture may be lost sight of for centuries. Tube making is now one of the most important branches of the iron and steel trades. Less than a century ago iron pipes did not practically exist in Great Britain, and yet it is undeniable that the use of pipes dates back to a very early period. In a description of the palace of Abdurrahman III., extant about 750, and situated at Zehra, in Spain, we find that metal pipes were used to convey both hot and cold water to the marble baths. A year after the battle of Waterloo, iron flange pipes were cast in two and one-half feet lengths, and packed at the joints with old hats. In 1811 and 1817 patents were taken out for welding barrels of firearms, and in 1824 James Russell took out a patent for constructing iron tubing, but about a year after Mr. Whitehouse took out a patent for an improved system, which was the beginning of our great tube industry.

The British Consul at Nantes sends home a report on the Nantes tramways, which are worked by compressed air, and which have now been established ten years. The working continues to be satisfactory, and the roads are a great boon to all classes. The cars are comfortable, they run smoothly and make little noise. They do not interfere with the ordinary street traffic, and there has been remarkable immunity from accidents. The average speed run is as high as eight miles an hour; it can be easily moderated or increased, and stoppage can be effected almost instantaneously. The machinery, moreover, is simple, and does not require a skilled mechanic for its management. Mr. Mekarski, who is the managing director, is the inventor of the system, which he asserts is cheaper than horse power, steam, or electricity. The cost of coal is only five francs a day, equal to eight or ten horse-power. Mr. Mekarski's system has been introduced at Nogent and Berne, and this year is to be applied to the Lyons tramways, which are at present worked by horse power.

A Water Railway.

The Paris correspondent of the London *Daily News* writes: "A press view took place recently of the so-called 'Chemin de Fer Glissant,' or 'slide railway,' on the Esplanade des Invalides, within the Exhibition. The new invention is a singularly original contrivance for enabling trains to run, by means of water power, at a speed hitherto undreamt of. Arriving there without any intimation as to what a 'sliding railway' might be, I at first mistook it for an overgrown switchback, with the humps smoothed away. The train consisted of four carriages, affording room for about a hundred passengers. The carriages had no wheels, being supported at the corners by blocks of iron of a size somewhat larger than a brick, which rested upon a double line of iron girders. In the middle of the line, at regular intervals, jutted out irregularly-shaped pillars, the use of which was not yet apparent. Having taken our seats, and the signal being given we glided along very gently for the space of a few yards, when suddenly we gathered speed; two or three tugs were felt, and we were flying on at the pace of an ordinary train, but as smoothly as a boat on a river. There was a clicking noise on the rails, but this, I was assured, was due to a defect in the construction of the slides, and would be remedied. The absence of any vibration, shaking, or 'tail motion' was wonderful. A slight jerk there was at regular intervals; but then, again, I was told that it was due merely to the shortness of the course and the inability to get up a proper pace. In a hydraulic train, traveling at full speed, that is to say, at the rate of 140 to 200 kilometers, or 87 to 124 miles an hour, there would be almost no consciousness of motion. The journey down the length of the Esplanade only occupied a few seconds. Upon our safe return, Mr. Pilter, chairman of the company which owns the invention, gave a full account of it. The sliding railway was invented in 1868, by an engineer named Girard, who was killed in the Franco-German war, and it has been improved to its present state by one of his assistant engineers, M. Barré. As has already been mentioned, the hydraulic carriages have no wheels, these being replaced by hollow slides fitting upon a flat and wide rail, and grooved on the inner surface. When it is desired to set the carriage in motion, water is forced into the slide or skate of the carriage from a reservoir by compressed air, and seeking to escape, it spreads over the under surface of the slide, which it raises for about a nail's thickness above the rail. The slides thus resting not on the rails, but on a film of water, are in a perfectly mobile condition; in fact, the pressure of the forefinger is sufficient to displace a carriage thus supported. The propelling force is supplied by the pillars which stand at regular intervals on the line between the rails. Running underneath every carriage is an iron rack, about 6 inches wide, fitted with paddles. Now, as the foremost carriage passes in front of the pillar, a tap on the latter is opened automatically, and a stream of water at high pressure is directed on the paddles. This drives the train on, and by the time the last carriage has gone past the tap (which then closes) the foremost one is in front of the next tap, the water's action thus being continuous. The force developed is almost incredible. There is some splashing on the rails at the start; but this diminishes the faster the train goes. To stop the train the small stream of water that feeds the slides is turned off, and the latter coming in contact with the rails, the resulting friction stops the carriages almost instantaneously. A water train running at over 100 miles an hour could, I was told, be pulled up within thirty yards; could climb up gradients of sixteen inches in the yard, descend them with equal safety, and run on curves of forty-four yards radius. This system would seem peculiarly adapted for elevated railways in cities, being light, noiseless, smooth, without smoke, fast and thoroughly under command. The danger of running off the rails is reduced to a minimum, the centre of gravity of the carriages being scarcely more than a couple of feet, from the rails. The cost of a metropolitan system would only be a third of one on the old plan, while in the open country its cost would be somewhat igher than the ordinary railway; but M. Barré tells me the expense would be in France an average of £8,000 a mile. Where no natural water supply is available, a propelling machine every twelve miles or so would be sufficient to keep trains going at full speed. The consumption of coal per passenger would be one-tenth only of the usual quantity. The importance of this may be realized by considering the statement that the Paris-Lyons Company alone has an annual coal bill of £2,000,000. Nevertheless, it would be rash to predict the general introduction of the water system on railways. One objection, for instance, that occurs to me is its apparent unsuitability for goods traffic. M. Percil, the manager of the Chemins de Fer Glissants, believes it will all but do away with the locomotive engine. With respect to England, he believes that the disadvantage of the present slow method of crossing the channel will become so apparent that all opposition to the tunnel will vanish. 'I am ready,' he said with enthusiasm, 'to wager any sum that when the tunnel is made, and our system is given a trial, people will go from London to Paris in two hours.'"

Compound Locomotives.

BY PROF. ARTHUR T. WOODS.

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FIRST PAPER.

The elementary theory of compound locomotives does not of course differ from that of other compound engines, whether they are condensing or non-condensing, or for stationary or marine purposes; but in applying the principles of compound engines to locomotives, while careful attention must be given to each of the many items which enter into the problem of designing any well-proportioned compound engine, it will be found that some factors, which are of comparatively small consequence in marine or stationary work, become of importance in the locomotive. These differences arise largely from the wide range of power required from locomotives, and the practical necessity of keeping the valve gear and operating mechanism as free from complication as possible. On the other hand, the recent introduction of higher pressures and greater piston speeds in marine practice has rendered some of the working conditions of marine engines and locomotives much more nearly alike than they have been heretofore.

ELEMENTARY INDICATOR CARDS.—The theory of the compound engine has been so thoroughly discussed by able writers, particularly in text books on the marine engine, that any further discussion seems almost superfluous; but as the most satisfactory method of designing any steam engine is to start with the elementary theoretical indicator card, and alter and adjust it here and there as experience and the special requirements of the case dictate, we will follow that method as far as practicable in considering compound locomotives. The type of compound locomotive which most nearly resembles the ordinary form of simple engine is the two-cylinder receiver engine having the cranks at right angles, the high-pressure crank leading. In this form, the steam, after expanding in the high-pressure cylinder, is exhausted into an intermediate receiver from which the low-pressure cylinder is supplied. We will first consider the form of the elementary theoretical indicator cards from such an engine, and for the present will assume that there are no clearance spaces, that steam is admitted and exhausted exactly at the beginning and end of the stroke respectively, that the point of cut-off is sharply defined, and that irregularity, caused by the angularity of the connecting rods, may be neglected. If with these assumptions steam is cut off at one-half stroke in each cylinder, the indicator cards would have the general form shown in Fig. 1.

The upper card, a, b, c, d, e, f, a, is from the high-pressure cylinder and the lower card e, f, g, h, k, e, is from the low-pressure cylinder. The cards are shown as they would be traced by the pencil of an indicator, which is applied first to one cylinder and then to the other, the same spring being used and both cards having the same length. The two cards are then fitted together as shown in Fig. 1, so as to represent the successive actions of the steam in the two cylinders, the cranks being at right angles. Referring to the high-pressure card, $a\ b$ is the admission line and $b\ c$ the expansion line, as in a card from a simple engine. At c the high-pressure exhaust opens connecting the high-pressure cylinder with the receiver and the pressure falls to d. The conditions which control this drop in pressure $c\ d$ will be discussed later. As we have assumed a cut-off at one-half stroke in each cylinder, the steam valve of the low-pressure cylinder closes just as the high-pressure piston reaches the end of the stroke at c. Hence as the high-pressure piston makes the back stroke, the steam is compressed in the high pressure cylinder and receiver until one-half the back stroke is accomplished at e. Here the low-pressure valve opens, admitting steam from the receiver to that cylinder, and from e to f there is free communication between the exhaust side of the high-pressure cylinder, the receiver, and the steam side of the low-pressure cylinder. At f the high-pressure exhaust valve and the low-pressure steam valve close, and the steam expands in the low-pressure cylinder to the end of the stroke g, when it is exhausted into the atmosphere as from a simple engine. The remaining lines of the cards do not differ from the corresponding lines in cards from simple engines.

FORMULAS FOR CALCULATING PRESSURES.—For calculating the pressures at the various points in the cards we can without serious error make use of the ordinary formulas for "moist steam," or in other words, assume that pressures vary inversely as the volumes, the curves of expansion and compression then being rectangular hyperbolas. On this basis mean pressures for such lines as $a\ b\ c$ are determined by the formula $p^m = p_1 \dfrac{1 + hyp.\ log.\ r}{r}$ (1). This will be recognized as the ordinary formula for mean pressures and in which p_1 is the absolute initial pressure, r is the ratio of expansion, and p_m is the gross mean forward pressure. The absolute pressure is the gauge pressure plus the atmospheric pressure, which is ordinarily taken as 14.7 pounds per square inch. Tables of hyperbolic logarithms or of values of the fraction $\dfrac{1 + hyp.\ log.\ r}{r}$ for various values of r are given in almost all books on the steam engine and will therefore be omitted here. As an example of the application of the above formula, let the gauge pressure at the point b in Fig. 1 be 145.3 pounds per square inch so that the absolute pressure will be 160 pounds. As cut-off takes place at one-half stroke the ratio of expansion $r = 2$ and therefore the final pressure in the high-pressure cylinder will be one-half of 160 = 80 pounds. From the tables previously referred to we find that for $r = 2$, $p_m = .847\ p_1$, and therefore $p_m = .847 \times 160 = 135.5$ pounds absolute pressure, which is the mean pressure between a and c measured from the zero line of pressures. This formula is applicable to such lines of the card as $a\ b\ c$ when $a\ b$ is parallel to the atmospheric line, as it is practically in engines supplied from a boiler and working at slow speeds. For calculating the mean pressure between b and c, d and e, e and f, or for other expansions or compressions in which the part of the card considered is wholly curved, or where no line of constant pressure as $a\ b$ is included, the formula

$p_m = p_1 \dfrac{hyp.\ log.\ r}{r - 1}$ (2) is to be used. This formula is deduced from the same theoretical considerations as the one given above, and the letters represent similar quantities. The former covers the whole stroke from a to c, and the latter only the curved part of the card as from b to c. For example, the pressure at b is 160 pounds and the volume at c is twice that at b. The ratio of expansion is therefore 2, and by reference to a table of hyperbolic logarithms we find

$p_m = 160 \dfrac{.693}{2 - 1} = 160 \times .693 = 110.9$ pounds between b and c. This is for one-half of the stroke, and for the first half,

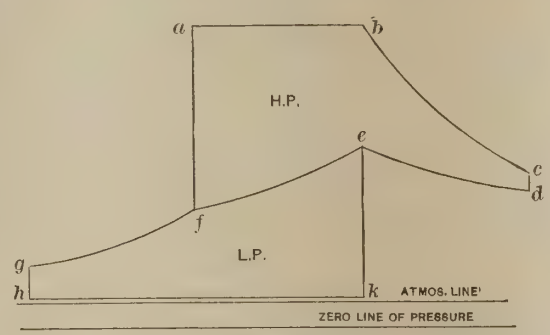


Fig. 1

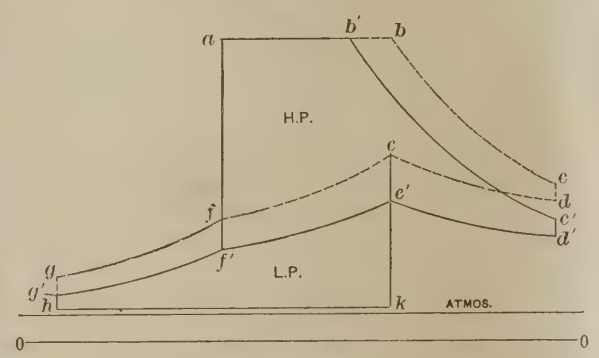


Fig. 2

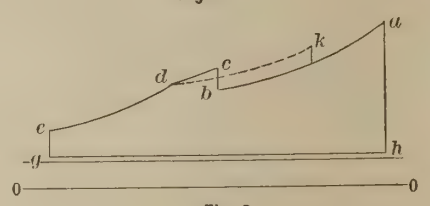


Fig. 3

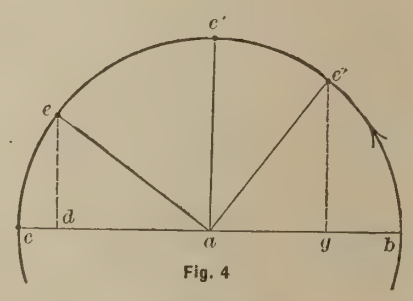


Fig. 4

from a to b, the mean pressure is 160 pounds, therefore the average for the whole stroke would be $\dfrac{160 + 110.9}{2} = 135.5$ which is the same as calculated by the first formula.

To avoid needless repetition, the following symbols, which will hereafter be used, are here inserted:

v = volume of high pressure (h. p.) cylinder in cubic inches.

V = volume of low pressure (l. p.) cylinder in cubic inches.

C = volume of receiver in cubic inches.

R = ratio of the two cylinders.

PRESSURE IN THE RECEIVER.—As before stated, there is in the case illustrated by Fig. 1, compression in the h. p. cylinder and receiver from d to e, and expansion in the h. p. cylinder, the receiver and the l. p. cylinder from e to f. How much the pressure varies between d, e and f depends upon the capacity of the receiver as compared with the h. p. and l. p. cylinders. In the present case, assume the capacity of the receiver to be equal to that of the h. p. cylinder, or $C = v$, and let the pressure at e be taken at 96 pounds. At d the steam fills the h. p. cylinder + receiver, and at e it fills one half the h. p. cylinder + receiver; therefore the compression is from $v + C = 2\ v$ to $.5\ v + C = 1.5\ v$, and the ratio of compression is $2\ v \div 1.5\ v = 1.33$. The pressure at d is then $96 \times .75 = 72$ pounds, and by formula (2) the mean pressure between e and d is $96 \times .86 = 82.6$ pounds. At f the volume occupied is that of one-half the l. p. cylinder + receiver. Assuming for the present case that the l. p. cylinder is 2.5 times the h. p. cylinder, or $R = 2.5$, the expansion will be from $1.5\ v$ to $\dfrac{2.5\ v}{2} + C = 2.25\ v$, or the ratio of expansion is $2.25\ v \div 1.5\ v = 1.5$. The pressure at f is then $96 \times .67 = 64$ pounds, and by formula (2) the mean pressure between e and f is $96 \times .81 = 77.8$ pounds. The following table shows the pressures at the points d, e and f of the h. p. indicator card with receivers having capacities of v, $1.5\ v$ and $2\ v$, and with cylinder ratios of 2 and 2.5, which give a sufficiently wide range to cover present practice in compound locomotives:

	Pressure at d.	Mean press. bet. d and e.	Pressure at e.	Mean press. bet. e and f.	Pressure at f.	Mean press. in receiver.
$C = \quad v, R = 2$.....	80	91.8	106.7	91.8	80	91.8
$C = 1.5\ v, R = 2$.....	80	88.9	100.	88.9	80	88.9
$C = 2\ \ v, R = 2$.....	80	87.4	96.	87.4	80	87.4
$C = \quad v, R = 2.5$....	72	82.6	96.	77.8	64	80.2
$C = 2\ \ v, R = 2.5$....	69.3	75.7	83.2	72 4	64	74.

An examination of this table shows that with the assumed cut-offs and relative volumes, the actual pressure in the receiver during one stroke may vary as much as 26.7 pounds, and that in all of the cases given the pressure at f, or the point of l. p. cut-off, is considerably below that at e, while the mean pressure between e and f does not differ much from the mean pressure in the receiver. In designing compound engines the pressure in the receiver is frequently assumed as constant.

It will be seen from the above that this assumption does not introduce any serious error as far as the h. p. back pressure and the l. p. mean pressure up to the point of cut-off are concerned. But as the pressure at f is considerably below the mean receiver pressure, the mean pressure between f and g, calculated on the basis of a constant receiver pressure, will be too high. In many cases, however, it is well-nigh impossible to predetermine the receiver pressure by calculations, and the best that can be done is to estimate it from the known pressure found in similar engines in practice. The nature of these difficulties will appear later, and for the present we will continue to calculate pressures, assuming as before that there is no condensation in the receiver. The table also shows clearly one result of changing the relative capacity of the receiver, viz., that the larger the receiver the smaller are the variations in pressure in it during a stroke.

FINAL PRESSURE; TOTAL EXPANSION.—In a compound engine, a certain fraction of the h. p. cylinder is filled with steam from the boiler at each stroke, and after expanding in both cylinders this mass of steam finally fills the l. p. cylinder before it is exhausted into the atmosphere or condenser. For example, if the cylinder ratio is 2.5 and the h. p. cut-off is at one-half stroke, $.5\ v$ is the volume admitted from the boiler at each stroke, and this finally fills the volume $2.5\ v$ before it is exhausted. The steam is therefore expanded to five times its initial volume, or the ratio of total expansion is 5, and the final pressure at which it is exhausted will be one-fifth of the initial pressure, or 32 pounds in the case we have used for purposes of illustration. Similarly, if the h. p. cut-off was at three-eighths stroke the ratio of total expansion would be $2.5 \times \frac{8}{3} = \frac{20}{3} = 6\frac{2}{3}$, and the final pressure in the l. p. cylinder would be three-twentieths of $160 = 24$ pounds. It will be noted that the only data required in determining the total expansion and final pressure are the ratio of the cylinders and the h. p. cut-off, or, in other words, these results are independent of the capacity of the receiver and of the l. p. cut-off. The effect of the size of the receiver is seen in the shape of the indicator cards due to the compressions and expansions; but how many or how large these variations are does not affect the final pressure. The office of the l. p. cut-off is to control the division of the work between the two cylinders. In a compound engine, which exhausts into the atmosphere, the steam can be expanded economically until the boiler pressure is reduced to the atmospheric pressure. Steam at 160 pounds absolute could, therefore, be expanded $\dfrac{160}{14.7} = 11$ times, nearly, if it were not for losses of pressure by wire-drawing, condensation, etc. In two cylinder compound locomotives, large ratios of expansion are also practically unattainable on account of the large l. p. cylinders necessary.

DROP IN PRESSURE IN RECEIVER.—We are now prepared to show how the receiver pressures which have been assumed can be calculated. Taking as before, $R = 2.5$, $C = v$, h. p. cut-off at one-half stroke, and l. p. cut-off at one-half stroke, we have the final pressure at the end of the expansion in the l. p. cylinder equal to one-fifth of 160, or 32 pounds. The ratio of expansion in l. p. cylinder is 2, therefore the pressure at the point f is $32 \times 2 = 64$ pounds. Then knowing the ratio of expansion from e to f, as already calculated to be 1.5, we have the pressure at $e = 64 \times 1.5 = 96$ pounds, which was assumed for the time in calculating the variations of pressure in the receiver. Working back from this still further, we find the pressure at d as before, 72 pounds, and as the pressure at c is 80 pounds, there has been a *drop* in pressure of 8 pounds when the h. p. exhaust opened. When the l. p. steam valve

closed at f, the pressure of the steam left in the receiver was 64 pounds. Then when the h. p. exhaust opened, the steam which filled the h. p. cylinder at a pressure of 80 pounds mixed with this, and gave a resulting pressure of 72 pounds. This drop represents an actual loss in the efficiency of the steam in the engine, since when it occurs the steam expands without doing useful work. It can be readily avoided, but in remedying this defect we may introduce others which are of more importance.

To prevent drop, it is only necessary to adjust the cut-off of the l. p. cylinder so that the volume of steam drawn by it from the receiver equals that of the h. p. cylinder. For instance, with the dimensions already given in this paragraph, it will be evident that when the l. p. cut-off is at $\frac{1}{2.5}$ or two-fifths of the stroke, there will be no drop, because two-fifths of the l. p. cylinder is equal to the whole h. p. cylinder in volume, and if we withdraw from the receiver at each stroke a volume which is equal to that received from the h. p. cylinder, the pressure in the receiver will not be reduced. This can also be readily shown by calculating back from the final pressure in the l. p. cylinder as before. Suppose $e\ f$ to represent two-fifths of the l. p. stroke instead of one-half, as shown in the figure, then the pressure at f would be $32 \times \frac{5}{2} = 80$ pounds, which would be the pressure in the receiver when the h. p. exhaust opened; and as this is also the final pressure in the h. p. cylinder, there would be no drop. There is, of course, always more or less drop due to wire-drawing and friction in passages which cannot be prevented, and it must also be borne in mind that all of these calculations are based on the assumption that pressures vary inversely as the volumes.

MEAN EFFECTIVE PRESSURE; EQUIVALENT PRESSURE IN ONE CYLINDER.—With the data already used the mean forward pressure in the h. p. cylinder was found to be 135.5 pounds. The mean receiver pressure, or h. p. back pressure, is 80.2 pounds, and thus the mean effective pressure in the h. p. cylinder is $135.5 - 80.2 = 55.3$ pounds. For the l. p. card, the mean pressure between e and f was found to be 77.8 and the pressure at f was 64 pounds. By formula (2) the mean pressure between f and g is $64 \times .693 = 44.4$ pounds. The mean forward pressure for the stroke is then $\frac{77.8 + 44.4}{2} = 61.1$ pounds, and assuming a back pressure of 18 pounds, or 3.3 above the atmospheric pressure, the l. p. mean effective pressure will be $61.1 - 18 = 43.1$ pounds.

As the ratio between the cylinder areas is 2.5, assuming the stroke to be the same in both cylinders, as it generally would be in practice, one pound per square inch on the l. p. piston is equivalent to 2.5 pounds per square inch on the h. p. piston. We can thus readily find the effective pressure in a single cylinder, which is equivalent to the effective pressure in the two cylinders of the compound engine. Ordinarily the mean pressure is thus referred to the l. p. piston, although a reference to the h. p. piston is more convenient for some purposes. In the present case, the effective h. p. pressure referred to the l. p. piston is $\frac{55.3}{2.5} = 22.1$. The total effective pressure referred to the l. p. piston is then $22.1 + 43.1 = 65.2$ pounds. From this we find that the proportion of the total work which is done by each cylinder is, in h. p., $\frac{22.1}{65.2} = .34$, and in l. p. $\frac{43.1}{65.2} = .66$. If the pressures are referred to the h. p. piston, we have $43.1 \times 2.5 + 55.3 = 107.8 + 55.3 = 163.1$ as the equivalent pressure in one cylinder of the same size as the h. p. cylinder. A common practice has been to make the h. p. cylinder of a compound locomotive of the same size as one cylinder of the simple engine which it is intended to replace. On this basis the theoretical compound engine under discussion would be developing the same work as the simple engine when the latter was developing a mean effective pressure of one-half of $163.1 = 81.6$ pounds in each cylinder.

EFFECT OF CHANGING THE POINT OF CUT-OFF.—If in Fig. 1 the h. p. cut-off is made earlier, while the l. p. cut-off remains as before at one-half stroke, a series of changes will be introduced, which are shown in full lines in Fig. 2, the lines of Fig. 1 being repeated in dotted lines. Assuming a cut-off at three-eighths stroke, the final pressure in the h. p. cylinder is $160 \times \frac{3}{8} = 60$ pounds, or at c' instead of c. Also, as the total expansion is now $2.5 \times \frac{3}{8} = \frac{20}{8} = 6\frac{2}{3}$ instead of 5, the final pressure at g is reduced to g', which represents $160 \times \frac{3}{20} = 24$ pounds. Then, as the h. p. cut-off is unchanged, the pressure at f is reduced to f', or $24 \times 2 = 48$ pounds. The steam which fills the h. p. cylinder at a pressure of 60 pounds is mixed with an equal volume in the receiver at a pressure of 48 pounds, giving a resulting pressure at d of 54 pounds. The results of this change are, then, that the forward mean pressure in the h. p. cylinder, the pressure in the receiver, the initial pressure in the l. p. cylinder, and the mean pressure in that cylinder are all less than before. The work done by the l. p. cylinder is therefore less, while for the h. p. cylinder we have taken from one part of the card and added to another part. The total work done by both cylinders is, of course, less than before, but the proportion done by the h. p. cylinder is greater, and, in fact, the mean effective pressure in that cylinder has been increased. When both cut-offs were at the same point considerably more work was being done in the l. p. than in the h. p. cylinder, but by making the h. p. cut-off the earlier of the two there is less difference in work than before, or, in other words, the work may be equalized by this means. A similar effect will, of course, be produced by making the l. p. cut-off *later* than that of the h. p., and conversely by making the l. p. cut-off earlier than that of the h. p. the proportion of the total work which is done by the l. p. cylinder will be increased. The following table calculated for $R = 2$ and $C = 1.5$ v will illustrate this:

Cut-off h. p.	Cut-off l. p.	Mean press. h. p.	Mean press. l. p.	Mean h. p. press. referred to l. p.	Total mean in one cyl.	Propor'n of work. h. p.	Propor'n of work. l. p.
$\frac{1}{2}$	$\frac{1}{2}$	46.6	54.0	23.3	77 3	.3	.7
$\frac{5}{8}$	$\frac{5}{8}$	51.4	39.6	25.7	65.4	.4	6
$\frac{3}{8}$	$\frac{3}{8}$	39.2	48 9	19.6	68.5	.29	.71
$\frac{1}{2}$	$\frac{2}{5}$	31.5	60.3	15.7	76.0	.21	.79

In practice the pressure in the receiver may be less than that calculated, on account of losses in the h. p. cylinder and passages. The effect of a lower receiver pressure is to increase the proportion of work done in the h. p. cylinder, so that by adjusting the valve gear to give an earlier cut-off in the h. p. cylinder than in the l. p., the total work may be very nearly equally divided between the two cylinders.

In Figs. 1 and 2 the l. p. cut-off has been taken at one-half stroke, and it was assumed that release occurred in the h. p. cylinder exactly at the end of the stroke. If now we make the l. p. cut-off later than one-half stroke, leaving everything else unchanged, there will be an exhaust from the h. p. cylinder, while the l. p. steam valve is still open, which will increase the pressure in the receiver and cause what may be called a re-admission in the l. p. cylinder. This is illustrated by Fig. 3, in which the h. p. exhaust occurs at b, causing a rise in pressure to c, from which there is expansion as before in the h. p. cylinder, the receiver and the l. p. cylinder until the l. p. steam valve closes at d. A similar effect will be produced by pre-release in the h. p. cylinder. An examination of a diagram such as Fig. 4 may make this subject more clear. In this Fig. $b\ c$ represents the stroke of the pistons and the circle the path of the crank pins. Taking the direction of revolution as indicated by the arrow, when the h. p. piston is at the end of a stroke or its crank is at $a\ \ c$, the l. p. crank will be at $a\ c'$, and the exhaust from the h. p. cylinder which takes place at this position of the cranks will cause the rise in the l. p. card shown at c, Fig. 3. If the h. p. exhaust occurs before the end of the stroke, for example when the piston is at d, the l. p. crank will be at $a\ e'$, and the l. p. piston at g, causing a rise in the l. p. card as shown at k. Fig. 3. In cards taken from an engine this increase in pressure will of course be more gradual, and at high speeds may simply cause the l. p. admission line to be more nearly parallel with the atmospheric line.

A Movable Fire-box Water Table.

It would seem that the merits of combustion chambers in locomotive boilers were recognized by most master mechanics, says F. N. Connet, in the *Stevens Indicator*, for they seldom hold an annual meeting without discussing them and appointing a committee to "look into them." Nevertheless, there are certain reasons making their use very limited, and while one is the first cost, the main one is the trouble connected with their maintenance. In boilers of the standard type there appears to be but one place for their construction, and that is directly behind the tubes in upper forward portion of the fire-box, from which it is separated either by an inclined fire-brick arch or a water table. The former requires frequent renewal, and though it adds nothing to the heating surface, yet it may be easily removed should repairs to the back tube sheet be required, and herein lies its great advantage over the latter. Indeed, the only way of getting at the crown sheet and back end of tubes on many New York Central engines is through an oval opening 17 × 22 inches.

There has not been to the writer's knowledge any attempt at making a removable water table, though this would combine the advantages, of both the rigid one and the fire-brick arch. Probably the reason for this is the difficulty of making tight, and yet flexible, connections with the sides of the firebox, and it is the belief of the writer that the principle underlying the accompanying design partially solves this problem. The use of corrugated metal has greatly extended in the last decade for all purposes requiring strength and a moderate amount of flexibility, and, as is well known, makes an expansion coupling for steam pipes quite superior to the stuffing box arrangement formerly used. Why, then, cannot corrugated tubes be used for the purpose in hand?

Mr. Connet then proceeds to propose the use of a water table, which he would have connected to the crown sheet by three corrugated pipe-sleeves, through which bolts would be passed to secure the device to the outside shell of the fire-box. The lower part of the water table he would secure to the front leg of the fire-box first by two compression couplings, one on each side, and further by four double elbowed ones, through which bolts would be passed to the outside. The author of the proposal then proceeds: "The hot gases will pass around this table, and, by impinging on the sides of the fire-box, make that portion a very effective heating surface. Hollow stays, or even one large opening, may also be used, and thus we will have a combustion chamber which, while allowing of easy removal, is the equal of any form now in use for consuming smoke and preventing sparks. It could be applied to almost any existing form of locomotive boiler, and would add 50 to 75 square feet of heating surface, and that of a quality very far superior to the same amount of tube surface."

The design of movable water table worked up by Mr. Connet is very ingenious, but he is not the first to make the attempt at a device of this kind. Mr. W. H. Lewis, superintendent of motive power of the Chicago, Burlington & Northern designed a removable water table some years ago, in which the connections were made by means of iron pipes. It was applied to an engine belonging to the New York, Chicago & St. Louis, but did not prove a success. If we remember rightly, the top of the table where the steam is likely to push the water away from the plate burned out, a point of weakness that has developed in all water tables that do not extend to the crown sheet.

New Spark-Arresting Smoke Stack.

Mr. Geo. A. Hancock, general master mechanic of the Atlantic & Pacific at Albuquerque, N. M., in the course of a private letter to the editor of this journal, says: "This company has adopted Brown's smoke stack, which has proved a success, and safe to use with any coal. Engines equipped with this stack steam well and are lighter on coal than others with the extension front." (The stack is of the large diamond pattern, with a spark reservoir in the shape of a funnel at the base of the diamond and a pipe leading from this into which a jet of water is injected to draw the cinders out.—ED.) Mr. Hancock continues: "It requires about fifty gallons water and steam per hour to form spray which comes in contact with the cinders about two feet from base of funnel. I have the stack on several engines; one 19 × 26 inch, 57-ton engine has Brown's stack with extension. Did not close up front end. The engine steamed good on first trip, the lifting pipe not being moved from position but placed according to judgment of foreman. Expect to get good result as soon as lifting pipe is placed in best position. A few cinders accumulated in front part of extension. Instead of running four-inch pipe from funnel down front of engine under trucks as on other engines, without extensions, the stack was placed so that funnel was at right angles to boiler. Pipe was run from funnel on a gradual incline under forward end of tank, dropping the cinders on the center of the track. This worked good and carried all dirt back of machinery. This plan allows the stack to be used without taking off extension from engines that have not too much weight on the engine truck.

"The motor roads in Lower California are putting on this stack and using "Gallup" coal from New Mexico. Heretofore they could not do this, on account of the coal being so light that the sparks thrown from it would burn up that dry country, and they had to use coal brought from Australia. The California Southern and the Southern Pacific are each putting on a stack for trial. If satisfactory they are likely to use coal off this road, which they have tried before but were compelled to abandon on account of the fires started. I think it will satisfy them, and if it does it will make lots of business for this company, as the coal fields are 650 miles from the west end of this road.

A 19 × 26-inch engine, cutting off at 17 inches full throttle, making 15 miles an hour, on a 52 foot grade, does not send a live spark out of the stack. Same engine with 4 × 5 No. 11, netting and extension front would illuminate the country."

An incident happened on the Delaware, Lackawanna & Western last month, which strikingly illustrates how intimately safety and disaster sometimes are entwined with each other in railroad operating. Some yardmen had been switching cars about noon at Orange, and a refrigerator car was left on the west-bound track without a brake being set, and it started moving eastward, there being a light grade at the place, which extends eastward for three miles and then increases in steepness to 120 feet to the mile for two miles, this part of the grade passing through the streets of the crowded city of Newark. The Delaware, Lackawanna & Western does about the heaviest suburban passenger traffic out of New York on this portion of the line. There is no block or signal system for the protection or prompt control of trains, and the runaway car ran on the track meeting all out-bound trains. It passed along the gentle grade, gaining speed slowly till it reached the steep grade, and then it was soon rushing along at the velocity of the fastest express trains. Fortunately the telegraph operator at Orange saw the car just as it got away, and he notified the train dispatcher at Hoboken, the terminus of the road, twelve miles from where the car started, and he with no less good fortune was able to stop, at a tunnel two miles from the starting point, an express passenger train which had pulled out bound west. He also ordered a drawbridge near the tunnel to be opened to intercept the runaway car. By a combination of fortunate circumstances the car was stopped without meeting a train, and what might have been an appalling disaster was averted.

Railway Car Construction.

BY WILLIAM VOSS.

Twelfth Paper.

FREIGHT-CAR TRUCKS (*Continued*).

The truck illustrated in Fig. 88 is the modern form of a variety that was once in universal use, but as it was then constructed almost entirely of wood, was abandoned for the diamond truck.

In its present form, with a continuous frame of bar-iron in the place of the old wooden wheel and end pieces, it is very much more substantial and durable, and has been selected as the standard truck by some very prominent railway companies, although its cost is from one-sixth to one-fifth greater than that of a first-class channel beam diamond truck. It does possess a very important advantage over other forms in that its frame, being placed above the burden springs, is not subjected to injurious vibrations. That some elastic cushion between the boxes and frame, or, a frame that is in itself elastic, is desirable is evident from the complaints heard from all sides about the difficulty experienced in keeping nuts on the bolts and rivets tight, where these are used to secure channel bars. Especially is this the case in winter, when the road-bed is frozen hard, consequently in the worst condition for absorbing shocks, and the track more rough than at any other time.

The foundation of this truck is a rectangular frame, formed from one bar of 1¼ by 3-inch iron, and is well calculated to resist spreading and getting out of square. This frame is supported near its four corners on coiled springs placed directly above and in contact with the journal-boxes, which are, for this purpose, provided with a suitable central or annular projection. A similar provision is made at the pedestal, whose principal duty is to retain and guide the box. It is of cast-iron in the shape of an inverted U, with the closed end attached to the frame and the jaws passing down on either side of the box, which has suitable flanges to confine it laterally. A ½ by 3-inch strap secured to the jaws by ⅝-inch bolts extends from one pedestal to the other, and is connected to its mate on the opposite side of the truck by a ⅞-inch tie-rod. The tie-rod is of but little if any service, the tie-bars being insufficient to resist the tendency of the pedestals to spread at the bottom. Two rods instead of one, and these placed as near the ends as the wheels will permit, would improve matters some; but it is questionable whether the whole arrangement of straps and rods is of enough benefit to pay for its application and maintenance.

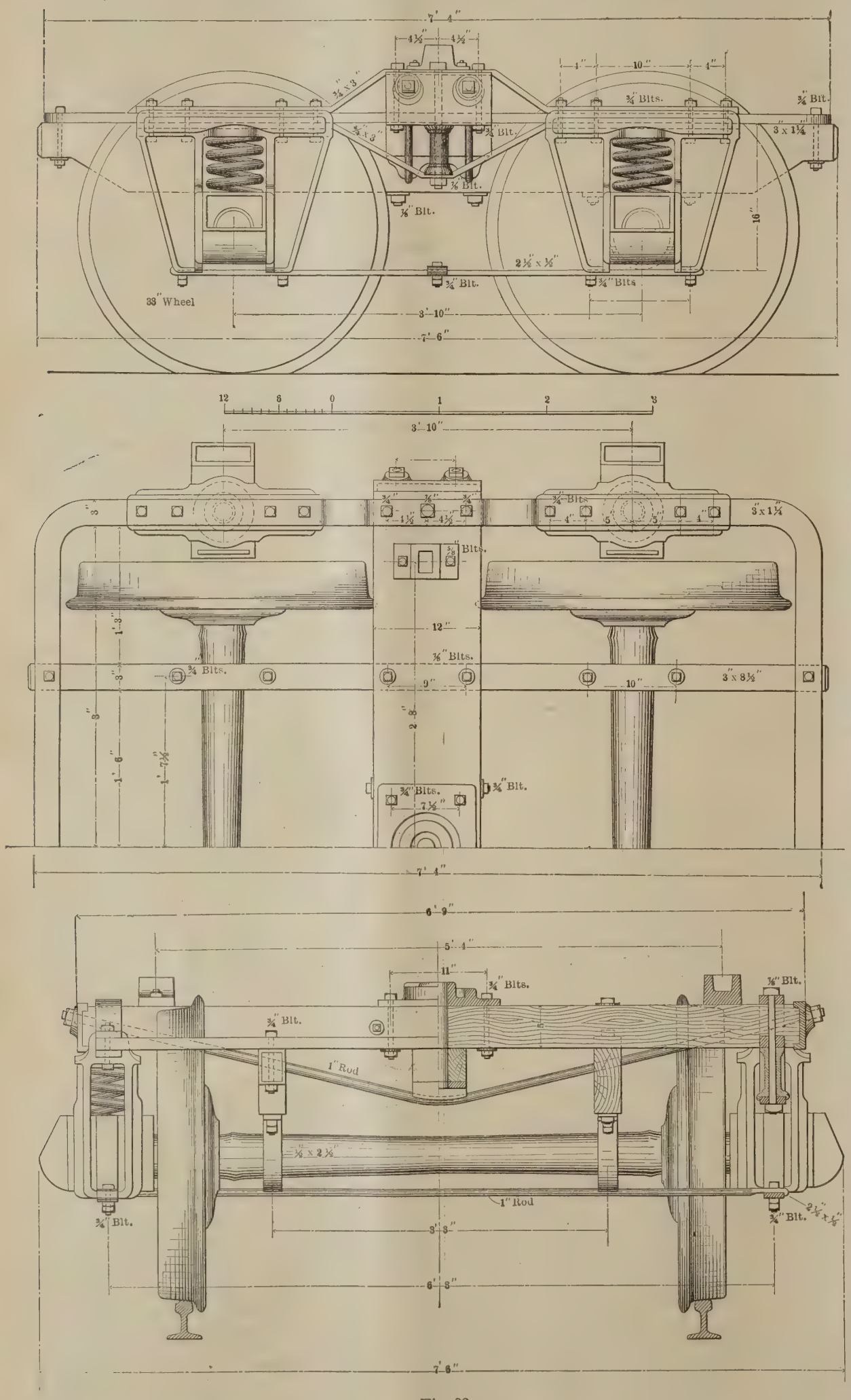


Fig. 88

The main frame, in itself too weak to carry any considerable load, is supported by a truss similar to that of the diamond truck, and, like this, formed of two flat bars, one above and the other below the frame. The ends of these bars, which are ⅝ by 3 inches, meet the frame above the pedestal, and are fastened by the same bolts that hold these, the bolts being usually four in number and of ¾-inch diameter. In the center of the opening formed by the upper or arch-bar and the frame is the bolster, the attachment being made by three vertical bolts, of which two are ⅝-inch and the remaining ⅞-inch diameter. The center bolt also passes through the inverted arch-bar and the intervening cast-iron post as shown.

The bolster, which is of 5 by 12-inch oak, placed across the frame and fastened as above described, carries the usual center plate and side bearings. It is strengthened by two 1-inch truss-rods, applied, as in all similar cases, with washer-plates and bearings, the washer-plates in this instance being of cast-iron, and made in the form of a cap to finish off the ends of the timber.

The continuous frame of this truck makes it practicable to introduce axle safety-beams and straps, and it is, therefore, usually equipped with these. Their object is to retain a broken axle in position until the train can be brought to a stop, and in all cases where the break occurs on the outside of the wheel-hub, as it usually does, serve the purpose admirably. The timbers used are of 3 by 8-inch oak, and extend the whole length of the frame, to the under side of which they are fastened, at a distance of about six inches from the wheel, by a ⅝-inch bolt at the ends and two ⅞-inch bolts at the bolster. To these timbers, corresponding with the location of the axles and surrounding, but ordinarily not coming in contact with them, are attached iron straps or guards, as shown. The straps are shaped from ½ by 2½-inch bars and fastened with ¾-inch bolts.

The advantages of the pedestal truck have been enumerated, but not its objectionable features. These are, first, a contracted spring-space, which cannot very well be added to without unduly enlarging the pedestal and journal boxes; second, the expense of renewing these pedestals and boxes when worn out.

An increase in the carrying capacity of cars intended for ordinary traffic, much beyond the present limit, is not likely; but should it be required, some radical change in the present arrangement of wheels and axles will probably be made. The weight now carried by each wheel of a box-car of 60,000 pounds capacity is, including the tare, not less than 11,000 pounds, or nearly the same as what, not many years ago, was considered the maximum load for a locomotive driving-wheel. This almost doubling of the load has not been altogether met by a proportionate increase in the sizes of the parts, nor is it due to a misunderstanding of the capacities of metals, but is principally the direct result of a more perfect road-bed and track, which enables a car to glide smoothly where formerly it was badly shaken up. To still further increase the load is not so much a matter of strength as of friction. Both wheels and axles can be made heavier, but to increase the diameter of the journals without a corresponding increase in the diameter of the wheels, to maintain the same number of revolutions, would be to multiply the chances of hot bearings. A wheel of larger diameter than the present is, for various reasons, not desirable, and difficult to obtain with cast-iron, without unduly increasing its weight. It is, therefore, advisable to increase the *number* of wheels and axles under a car rather than adding to the weight carried by each.

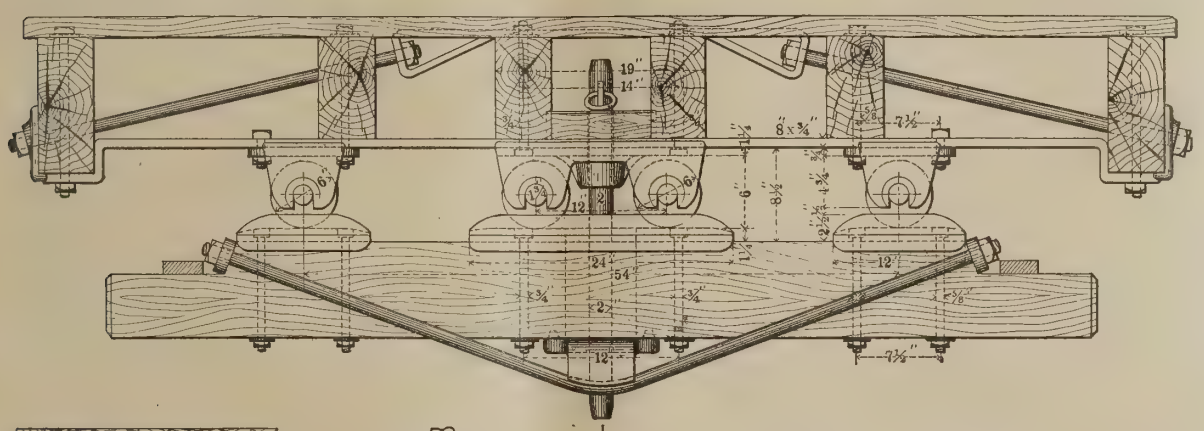
This has been done in the isolated cases, where cars have been built to carry 80,000 pounds, and for a number of years with cars of less capacity. In one instance, the extra wheels have been arranged as under the heavier passenger cars; that is, six wheels to a truck. But in the majority of cases the car is fitted with a third truck.

The third truck is placed under the center of the car and may be of the same pattern as that adopted for a standard on the road this system is used, but should preferably have a rigid bolster; although a swing-motion truck may be utilized by either blocking the swing-beam or by supporting the weight direct on the transom. The center truck differs from those at the ends of the car in the arrangement of center and side bearings only. These must be constructed in such a manner that the truck may move freely in a lateral direction, the distance of which is governed by the length of the car body and the radius of the sharpest curve it is expected to pass over. The ordinary swing-hanger will not answer in this case, as its motion is too limited and does not keep the bolster at the same level; roller-bearings are therefore used.

Fig. 89 is a cross-section through a car body near its center showing the body and truck bolsters and one form of roller bearings; the proportions are large and suitable for the heaviest cars now built. The body-bolster, although of iron, is trussed like a wooden bolster, as there is not sufficient room for the introduction of the usual compression bar. The bar of iron it is shaped from is ¾ by 8 inches, and

the other parts are of the usual dimensions. Truss-rods for the body are not shown in this sketch, the short distance between the supports making them less necessary, but if used in the case of cars of extreme length, may be hooked over the transom, or, if continuous, rest in cast-iron saddles above the transom. The rollers are of cast-iron, 6 inches long and the same number of inches in diameter, this large size being selected to lessen the chances of wearing flat. The rollers are four in number, one on each side of the center pin, and the others corresponding in position as near to that of the ordinary side-bearings as possible. They are supported on flanged cast-iron plates securely fastened to the truck bolster, the one in the center carrying two rollers receiving four ¾-inch bolts and those at the ends four ⅝-inch bolts. Above these and fastened to the body-bolster and sills, by the same number and size of bolts, are boxes or brackets likewise of cast-iron, which bear on and guide the rollers by means of 2-inch journals provided at the ends of these. The flanges on both upper and lower plates must be of ample strength, as they are subjected to all the strain coming on the flanges of the center plates of ordinary trucks; a shorter roller than that shown is for the same reason not practicable, being too apt to upset when the car is moved suddenly.

No provision is made in this case for an angular adjustment of the truck other than that derived from the considerable amount of clearance allowed between the ends of the rollers and the flanges of the guides; and none is necessary, as the truck remains parallel with the car body on a true



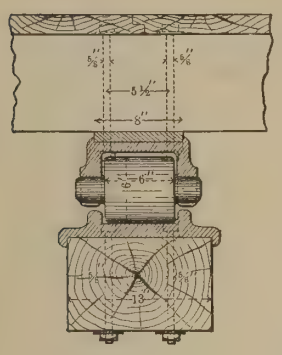


Fig. 89

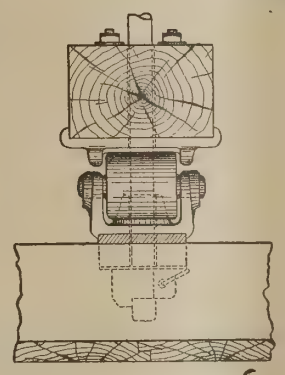


Fig. 89

curve, and deviates from this only on a reversed curve or on the approach of one of a very short radius, and then but little.

The arrangement as above is, perhaps, not the best possible, but in the absence of something more satisfactory has been selected for the purpose of description. It possesses at least the virtue of simplicity and strength which the so-called anti-friction forms do not. Should the third truck ever be more generally adopted, the proper attachments for applying it is certain to suggest itself after experience has pointed out the weak spots. Three trucks have so far been principally put under platform and open cars only; whether the superstructure of a box-car would suffer to an appreciable extent from the slight inequalities of a good track is, perhaps, questionable, but it is certain to do so on a large proportion of the tracks still in existence; the six-wheel truck, and two trucks to a car, will probably be adopted for the box-car of the future.

Superiority of Cast-Iron over Brass Slide Valves.

On most railways in Europe brass or bronze slide valves are almost universally used on locomotives, yet when good cast-iron valves happen to be tried they almost invariably give better satisfaction than those made from the expensive alloys of copper. The writer was familiar with a case on a division of a British railway where an engine had given intense annoyance by the rapid wear of the valves, and the foreman in charge obtained permission to try a set of cast-iron valves, which proved highly durable, yet that proof of the superiority of cast-iron for slide valves exerted no influence on the practice with other engines.

At a meeting of the Institution of Civil Engineers, during the discussion of a paper by Mr. J. A. F. Aspinall on "Friction of Locomotive Slide Valves," Mr. J. C. Park, of the North London Railway, who had some experience in Canada, gave striking testimony in favor of cast-iron as a material for slide valves; but his words appear to have had no effect in overcoming the general prejudice in favor of brass. Mr. Park said: On the North London Railway where more than 7,000 stoppages were made daily, the engine drivers much preferred cast-iron valves, as they were able without effort to work the reversing lever quite easily with steam at 160 pounds full on, whereas, with brass valves, they were compelled to partially close the throttle while moving the reverse lever. The wear was 1 to 3 in favor of cast-iron valves.

An Improved Mileage Card.

Mr. E. W. Yates, chief clerk of the motive power department of the Chicago, Burlington & Quincy Railroad at Aurora, Ill., has planned a new style of mileage and coal card for locomotives, which we consider would be of very great value to railroad companies if generally adopted. The card is devised to provide for a daily record of fuel consumed on engines, so that the advantage of knowing results when they are fresh can be had almost at once, in place of the long time elapsing before results are worked out; to provide for a record of fuel performance by trips, so the monthly performance will be known in detail by trips, as against the present plan of consolidation of results in one figure; to provide for greater economy in coal consumption by giving the master mechanic an opportunity of raising his averages by the advantage of following closely the performance of engines, which the data on the card will furnish; to stimulate the enginemen to do better by the fact that the record is one of daily or per trip account, and thus make a very close connection in saving time by having immediate results; to provide for a record per man in place of per engine, the advantage of which will be manifest.

The adoption of the plan outlined would overcome the defects of the monthly mileage sheet, which seldom appears less than two months after the work which it records was done. A bad performance is then so far gone that it is likely to be overlooked, and the opportunities for inventing excuses are greatly increased. When a master mechanic could say to an engineer or fireman, what was the matter that you burned so much coal on the run yesterday? there would be much greater stimulus to attending strictly to business.

Louisville & Nashville Items.

Mr. Pulaski Leeds, who has recently been advanced to the position of superintendent of motive power of the Louisville & Nashville Railroad, and who is well known to our readers as the inventor of several labor-saving machines and devices, has just completed and has in use at the Louisville shops of the company a cylinder borer of great merit. The cylinder is bolted to a carriage similar to a lathe carriage. Through it a bar is placed with a traveling head having four cutters. Six hours is sufficient to bore out, face and counterbore a new cylinder casting of 18 × 24 inches. The merits of the tool lie in its cheapness of design and construction, together with its speed in operation.

Mr. Leeds has long been recognized as one of the leading shop managers, and since his accession to the head of the mechanical department of his road, has demonstrated his pre-eminent fitness for the position by his comprehensive grasp of the whole.

He is introducing systems of economy in the use of fuel, and favors the piece system to as large an extent as it can advantageously be worked.

Side rods are fitted with strap and taper bolts, but without keys or wedges, making virtually a "solid brass" in two halves. Mr. Leeds has found that many of the 18 × 24 inch cylinder eight-wheel engines, are but indifferent steamers, and is replacing their boilers with new ones of 56-inch shell and 205 flues. The fire-boxes are of the Belphair type, with the bottom slanted up so as to pass over the back driving axle and extend two feet back of it.

Russia Iron.

A Pittsburgh metallurgist, who has made a study of Russia sheet iron, writes to the *American Manufacturer* giving his views on the cause of the thin sheet covering that is used for locomotive jackets being so much less liable to oxidation than imitations produced in this country. Nearly all railroad men have had good reason to note the difference in quality in the native product and in that which is brought from Russia. The correspondent referred to says: "Kavlin, used largely in the production of aluminum, is found in large bodies throughout the iron manufacturing districts of the Ural mountain. It was among the very earliest discoveries of the Russian iron manufacturers that the kavlin could be utilized in smelting their ores, and that when so used the finished product in the form of sheets presented a strong resistance to the oxidizing action of the atmosphere. What element the kavlin possessed that it could give to the finished product its high quality was not at first known, but subsequently it was learned that in the course of smelting the iron ore with the kavlin, a small percentage of aluminum was extracted from the kavlin, and this aluminum entered into combination with the iron, and as it was subsequently reduced to sheets, the oxide formed thereon in the course of such reduction rendered the iron highly non-oxidizable, and it is now known that it is the combination of this small percentage of aluminum with the iron that gives to the oxide which they build upon the surface of the sheet the feature that makes the Russian sheet valuable."

The intention of Pittsburgh iron manufacturers now is to attempt to produce a non-oxidizing surface on thin sheets, by employing oxide of aluminum by a direct process.

Preparations are going on to span the Hudson River by a great suspension bridge at Peekskill, for the use of the New England Railroad. Very great care has been devoted to the selection of wire for the cables of the bridge, and General Serrell, the Chief Engineer, has recommended that the contract should be awarded to Bullivant & Co., of London. There has been great competition for this contract, which is one of the largest for steel of this kind ever undertaken by one firm; it will amount to over 6,000 tons. For more than a year the contract has been sought by the most prominent wire-makers of the United States and Europe; many hundreds of tests have been made by the government testing-machines and by the wire-makers, both here and abroad. The object of the company has been to get the very best that could be had in the world. There are to be 954 strands each composed of 61 wires, and each to be more than a half mile long. There are not to be any joints or welds in any of the wires, or any tucks under, and the strands are to be made with reference to carrying the greatest possible weight with the least amount of metal, and it is said that the metal recommended is the strongest ever used. It will be exclusively crucible steel. The makers offer to deliver the entire quantity within eleven months, ready for erection. The Highland Bridge has been under construction for some time, and the foundations on the east side are completed, while those on the west side are in rapid progress. The length of the span over the river will be 1,620 feet between the faces of the masonry, which is slightly in excess of the length of span of the Brooklyn Bridge.

Electricity is not dangerous, according to the companies, and persons who have been killed by it must be mistaken. Nevertheless it acts violently sometimes. A president of a car motor company was lately showing visitors about the place when something happened. President Bracken pointed out how the machine worked, while the others kept at a respectful distance. He put his finger on an iron shaft, which was revolving at a good speed, to show that there was no danger in it. There were two metal rods which ran from the machine to the ceiling, and which looked like some kind of a support or connecting rods. Behind them were two ordinary telegraph wires which ran the same way, but which had a dangerous look about them. Mr. Bracken inquired of the man in charge whether the last two wires were dangerous to touch. In doing so he leaned forward and rested against the two innocent looking rods. He rested—only for the least possible fraction of time—when, like a flash, he was knocked over and landed half way across the room on his back in an empty drip pan. The rest of the party thought him stunned at first, and Commissioner Baker ran over to help him to his feet, and in touching him received a severe electric shock in his right arm. Mr. Bracken assured the party that he was uninjured, and conducted them through the other parts of the machine shop.—*Engineer, New York.*

A machine has recently been perfected that is warranted to make at half speed 12,000 nails a minute, or three tons per diem. The inventor is a New Englander, and the process is said to be of the simplest description. Instead of the ordinary shear-like cutters heretofore employed, the latter consist of small sheet dies imbedded in two narrow cylindrical rollers having the appearance of cogged wheels. The strips of iron or steel are fed between the rollers and the dies or cogs, cutting the nails at the rate above given. Movable steel teeth placed between the cogs are forced toward the center of the cylinder to the point of contact with the dies, and in the course of the revolution come in contact with a steel shaft which pushes them upward and forces the nails from between the cutters, whence they drop into a spout or conductor. Another feature is that, by means of a single leverage system of inclined planes acted on by screws, the cylinders can be adjusted in their relations to each other to the ten-thousandth part of an inch. The dies are replaceable, and can be ground without being removed from the cylinder.—*Iron Industry Gazette.*

Communications.

Effect of Wetting Coal Used in Firing.

Ed tor National Car and Locomotive Builder:

We have been all supplied with your book on "Combustion in Locomotive Fire-boxes," and it leads to no end of discussion as to how firing can best be done to save coal. Some of our men agree with every word said in the book, others have different opinions about firing. I want to ask you one question that the book does not throw any light upon. Is it better to fire with dry coal or wet coal? Some men say that the wetter the coal the hotter the fire it will make, and they refer to the example of the blacksmith, who from time immemorial has been in the habit of wetting his coal to help him in getting a good heat. That is done I admit, and would not be done if the blacksmith did not find the practice helped him. It looks, however, as if the fire-box of a locomotive was worked differently from a blacksmith's forge, and I scarcely think that the cases are entirely the same. I know when there is much snow mixed with the coal that it is hard getting an engine to steam, and snow ought to intensify the heat of the fire if water does it. I have repeatedly thrown small quantities of water on an open fire, but it always appeared to decrease the heat. It is common sense to think that water does dampen a fire, and I take no stock in wet coal acting the opposite way, the blacksmith's practice notwithstanding. FIFTY-NINE.

[In a general way our correspondent has got correct views of the effect of water on a fire. There is a widespread but erroneous impression, that wetting the coal which is thrown into the fire-box of a locomotive intensifies the heat of the fire. This no doubt arises from the practice of the blacksmith alluded to by our correspondent, but the blacksmith wets his coal to form an outside shell, which keeps the heat concentrated about the forging, not that he thinks that wetting it will make the coal create a hotter fire than can be made with dry coal. When wet coal is thrown into a furnace, a portion of the heat already generated is wasted evaporating the water before the coal can perform its functions as fuel. Every pound of water thrown into the fire-box with the coal has to be evaporated, just the same as the water used in steam-making, and coal has to be wasted in doing the work. Evaporating water in the fire-box has some disadvantages peculiar to itself, and the practice would be much less common if those who encourage it fully realized the great waste of heat that results. Wetting the coal, to some extent, is necesary to keep the men in the cab from getting blinded with dust, and it sometimes gives sufficient adhesion to slack coal to keep the finer particles from going direct from the scoop to the flues. But to suppose that any increase of heat results from the coal being saturated with water is a very great mistake.—ED.]

Favors Piece-Work in Railroad Shops.

Editor National Car and Locomotive Builder:

I have been a reader of your paper ever since it first started, and I have liked it for its consistency, and because it has always been progressive. That has been my opinion, and holding that opinion, I was very much disappointed on reading what was said last month about contract work in railroad shops. It is breaking your record to go back on contract work. Doing work by contract is the best thing all round that ever has been brought into railroad shops. It is the natural outgrowth of the system of interchangeable parts that was originated by the genius of an American mechanic, and has been perfected by other mechanics no less gifted. This is a good time to look back at the origin of the system that will make work done, the basis of pay in all railroad shops before many years pass.

Just a century ago Eli Whitney, a native of that cradle of great men, Massachusetts, caused a revolution in American cotton industries by inventing the cotton gin, the first practical contrivance for mechanically separating the cotton from the seed. Failing to receive his just due for the improvement he made in peaceful implements, Whitney turned his attention to the making of weapons of destruction, and he met with great financial success. This was principally due to the superior methods of production which he invented. Till that time every part of a gun was made for that particular gun and would not fit any other one. Whitney invented the plan of making every lock, stock and barrel exactly alike and interchangeable. His system was many years afterward introduced into all the government armories of Europe. The system was soon afterward adopted in the clock-making trades, and the cheap and rapid production that followed enabled the clockmakers of Connecticut to send their clocks into all the markets of the world and undersell the cheapest hand labor of Europe. After that sewing machine makers adopted the Whitney system of manufacture, and then it gradually extended to all machine trades. An essential element of the system is that results form the basis of remuneration.

It is not possible to introduce the Whitney system pure and simple into railroad shops, but as much as possible of it has been successfully worked for years in many important shops that are second to none for turning out machine work at low cost, and for the good pay given to the workmen. Piece work needs a little more supervision than day work, but it is the fault of the men in charge if the work put up is not equal to jobs done on the day pay system. Where piece-work is intelligently run, it is better for the men and better for the company than day work. The men earn more, even when they work at the same pace, for they have an inducement to take advantage of every means of increasing the extent of their output, and an intelligent man will nearly always scheme some means of increasing his production without increasing his labor. Then it takes away inducements to loafing. No foreman can entirely prevent some men from idling away a great part of their time, but working by the piece makes the idle man play on his own pocket. A great many workmen are disposed to think that there is nothing wrong in cheating railroad companies by "soldiering." Piece-work is the best means I know of for strengthening out their moral perceptions. The system is really a moral reformer for the workmen, and puts them into a conscientious attitude toward their employer. While doing no more labor then many mechanics on day work have to perform, the piece-work men receive from 20 to 50 per cent. more pay than those who are rated by the day, so there is the very best inducement for industrious mechanics to favor the contract system. To be sure, it is hard (blotting out indeed) on the lazy man, but the majority of mechanics are interested in having the lazy man forced out of their ranks.

Now for the companies' side of the question, which is the one most of your readers are interested in. The practice of doing work by the piece doubles the capacity of the tools in a shop, and enables a company to perform its business with a small plant and with a small force of men, which is often a very great convenience, to say nothing of the saving. The saving is also about 50 per cent., and every railroad officer zealous for the interests of his employer ought to make it his business to introduce and properly work a system that does so much good all round. Very close connection with the working of the piece-work system for seven years makes me think that there is no truth in your assertion that the contract system of doing repairs shortens the time an engine will run between general repairs. Where this happens (and it may happen on some roads) it is the fault of the inspectors. A system of piece-work properly organized makes the man to a great extent inspectors of each other's work, but bad work will sometimes creep through, and it is the duty of the foreman to keep down the possibility of letting through work not properly done. Where supervision is properly carried out, there is no inferior work worth speaking of passed, but railroad companies could afford to have their locomotives and cars coming in a little sooner for repairs, when the repairs are done 50 per cent. cheaper than they were under the day system of working. That is an argument that cuts both ways. The enemies of progress always find some excuse for opposing change, and that is about all there is in the objections to the general introduction of piece-work into railroad shops. P.

Place of Next Convention.

Editor National Car and Locomotive Builder:

Your correspondent "Harmony," in last month's CAR BUILDER, wants to harmonize things in too one-sided a fashion. He would make everything lovely for both the Master Car-Builders and Master Mechanics' Associations by having the master mechanics abandon their choice of three healthy places for holding their convention, and go away down to the sweltering swamps of South Carolina. I am very much mistaken if the master car-builders will not be sick enough of their choice before they are done with their convention at Charleston.

I have had occasion to meet many members of the Master Car-Builder's Association since the Saratoga convention, and I find the very strongest dissatisfaction expressed about the decision as to next place of meeting, and especially with the silly, babyish way in which the convention acted in suspending a sensible rule to take away the power from the executive committee. There is a decided opinion abroad that the handful of members present when the decision as to the next place of meeting was made acted not only like a parcel of hysterical women, but that they overrode the spirit of justice and fair play by presuming to suspend a rule, which had the effect of making that small rump of the association greater than the whole body.

There is no reason in the world why the master mechanics should change their plans to accommodate the master car-builders. In selecting their place of meeting for next year, I consider that the Master Car-Builders' Association treated the Master Mechanics' Association *with marked and studied discourtesy*, and I am by no means solitary in this opinion. As the Master Car-Builders' Convention has always previously been held before that of the master mechanics', the decision of the next place of meeting has generally been settled by the master car-builders, and the master mechanics have invariably decided to go to the same place, or to one conveniently near where the master car-builders were to meet. This year when the master mechanics were first to hold their convention, and therefore first to decide on a place of meeting, it might have been supposed that common courtesy would have moved the master car-builders to follow the lead of the master mechanics; but, instead of that, they make a hard and fast selection of a place 400 miles away from the nearest place and 1,100 from the farthest place that the master mechanics can go under their rules. There is certainly no encouragement for the master mechanics to put themselves about for the accommodation of the master car-builders. MASTER MECHANIC.

Ambiguity of Rules About Carding Cars.

Editor National Car and Locomotive Builder:

The question, for what purpose the M. C. B. defect card was intended, is not defined so as to enable all to comprehend the rules for 1889. Giving no further interpretation than heretofore, they may be clear to those who framed them, but not so to inspectors and others who do not attend the yearly meetings. Rule 4 does not make any distinguishing point between old and new defects, defects for which the delivering company and those for which owners are responsible, and is possibly intended that all defects, either new or old, should be carded indiscriminately; but it would seem a little strange that Rule 11 would indicate that owners would accept their cars when in condition to require general repairs. Now, if any owners are satisfied to accept their own cars in this condition, where is the consistency of carding defects of this character on foreign cars on their route home with a defect card that will make the company applying same responsible? It is certainly an injustice to any company that is willing to accept their own cars for general repairs. If a delivering company must card for old and new defects, then every defect would be covered, and the owners making repairs would be justified in taking off cards and making bills for all defects on same, except what they had applied. This certainly would be a revolution in the present mode of doing the work, and is a question that should be thoroughly understood. Either the matter should be made clear in the rules, or a second pass card established for old defects and used for a purpose of a record in transit, the card being valueless for any other purpose. J. C.

He Wanted Smaller Nozzles.

"There's no use talking, Mr. Wayfarer," said Engineer Alexander the other day, as he stuffed about two-thirds of the tobacco from the scribe's box into his mouth, and then resumed his work of pushing other material into a stuffing box; "you may talk to me as long as you please about my practice of throttling, but it's the fireman that wastes the coal," and he gave a vicious shove with the packing iron as if to emphasize his opinion.

"Well, but don't you think," said the Wayfarer, "that hard hitting with the lever in the corner has something to do with waste of fuel? Don't you think that irregular boiler feeding with no judgment produces a bad record? Let us not be too hard on the poor coal jerker. Don't you think that you, for instance, would be easier on the coal pile if you were in the habit of letting steam into the cylinder at nearly boiler pressure for one-quarter of the stroke, and then cutting it off, instead of reducing the pressure by throttling, and then half filling the cylinder at each stroke to do the same amount of work that the quarter measure of steam would do if expanded in the cylinder?"

"Young man, I have run an engine seven-and-twenty years, and I never learned anything about a locomotive from a book. I wouldn't give the snap of my finger for a man who is a book engineer. I guess I know how to run an engine without getting points from dod-gasted lawyer engineers;" and Mr. Alexander glared round with his black eyes as if they would obliterate his interlocutor, and all other pretenders at knowledge who go about asking annoying questions.

"There's one thing better than all your books," continued the irate engineer, "and that is, that an engine requires a big hole to get the steam out by when once it is used. I am no small nozzle man. Running an engine has shown me that the bigger the opening is for the steam to get out, the better the engine will do her work. But your school firemen, with all their pretence at knowing things, are always wanting the nozzles bushed. Day after day it is, 'Uncle John, don't you think a little smaller nozzle would make the engine steam better?' Your men talk and talk about expansion and full throttle and what not, but it would be better if they would attend to their own side.

"There is my fireman Pat Lane," continued the old man, "a shining light among your book firemen. He kept at me day after day to get the nozzles bushed. I paid no attention, and one day that we were in for washing he gets round the foreman and has him put in a set of smaller nozzles on the quiet, thinking I did not see what was done. I said nothing, but in the evening I slipped into the round house and put back the old nozzles. When we got out on the run next day the engine was kept red-hot, a thing I had not seen much of for weeks. Pat kept drawing my attention to how freely the engine was steaming, and then, after he thought I had got properly prepared, he told me that he had had smaller nozzles put in. The improvement in the steaming of the engine was wonderful. It was about a month afterward that Pat found a set of nozzles in the tank-box, and asked me what they were. "Oh," I said, "they are the small nozzles you fellows put in. I changed them that night after you went home." Pat looked queer, but said nothing. He manages to keep up steam with the large nozzles, though. You fellows do not know everything;" and Mr. Alexander gathered his packing tools and climbed into the cab, with a mute intimation that he took no stock in people who had not been privileged to run an engine for twenty-seven years.

How to Earn Promotion.

The increasing complication of mechanical appliances that the master mechanic of a railroad is nowadays expected to exert intelligent control over-calls for the employment of men with first-class mechanical training, so that the chances for the man who begins work as a fireman ever reaching the position of master mechanic are becoming very small. But men who began work as firemen occasionally became master mechanics, and when this happens, the man who gets there generally deserves very great credit. The following notes of advice to firemen are very seasonable, for they were written years ago by a man who had just been raised to the right-hand side, and who has now been promoted to the position of master mechanic.

The attention of firemen is called to a few facts in the following, which are intended for their benefit, in aiding them in the early securing of a promotion in case they desire it. Nearly all engineers have an appreciation for a clean engine, for it is the machine with which they earn their living. The locomotive cab is the office of the engineer who pulls the train from city to city and ocean to ocean. The cab and exterior parts of an engine are to its engineer the same as the office is to the general superintendent. We, as employés of a railroad company, very well know that all offices must be kept clean and tidy during office hours, and everything appropriately arranged in the offices before the officers resume their duties for the day. So it should be in the cabs of all locomotives, especially those used for pulling passenger trains. When an engine is coupled on to a passenger train it should present a clean and tidy appearance, for it is a part of the company's equipment, for which they have paid a large sum of money. The master mechanic intends, when an engine leaves the yard, that it is clean and merits the admiration of both passengers and men who stand on the street corners waiting for something to turn up. The cleanliness of locomotive cabs and their contents and certain exterior parts of the engine depends much upon the interest the fireman takes in his occupation. The fireman of a locomotive is the engineer's helper; I may correctly say he is an apprentice to the trade or profession of locomotive engineering, for it is supposed when he accepts the position as fireman that he means to qualify himself for running and taking care of an engine, after a reasonable term of firing. His duties are, indeed, numerous. He has many little things to do, such as filling oil cans, wiping them off, keeping tools in place, cleaning and filling lamps, etc. He is supposed to help his engineer when he (the engineer) has anything of importance to do on his engine. If the fireman means to become a successful runner he must at all times strive to relieve his engineer of as much as he can conveniently do, for while he is a fireman he should learn to do engineer's work, and acquire the foresight and skill of doing it in haste, so as to avoid all delay on the road. But instead of finding firemen who possess a willingness to give a hand in many cases of need, we find them sitting in the cab, reading literature which is in no way refining to their morals nor improving to their intellect. Many firemen seem to defer all opportunities for learning the profession of locomotive engineering until they are promoted to the position of engineer. Such should not be the case; all firemen should cheerfully discharge their duties in a manner that will command the admiration of the engineer for whom they fire and the attention of the M. M.

Increasing Popularity of Steel.

Ex-Mayor Abram S. Hewitt, of New York City, returned from Europe last Saturday, and conveyed to a reporter of the New York *Sun* some interesting statements of his observations at the Paris Exhibition, and deductions therefrom, as follows:

"The one new thing that is likely to attract attention from engineers is a process for making frames for locomotives and cars of all sorts from sheet steel. The frame is formed out of a sheet of steel by hydraulic pressure. This would have been impossible twenty years ago, because the iron plates of that time would not have stood the strain of such an operation. That was to me the most striking thing in the Exposition. People have been wondering where the next opening for the use of steel was to be found. There is no doubt that it is in the manufacture of car frames. The ordinary frame will rot out, say in ten years. I should think that a steel frame might still be in excellent condition after being used 100 years.

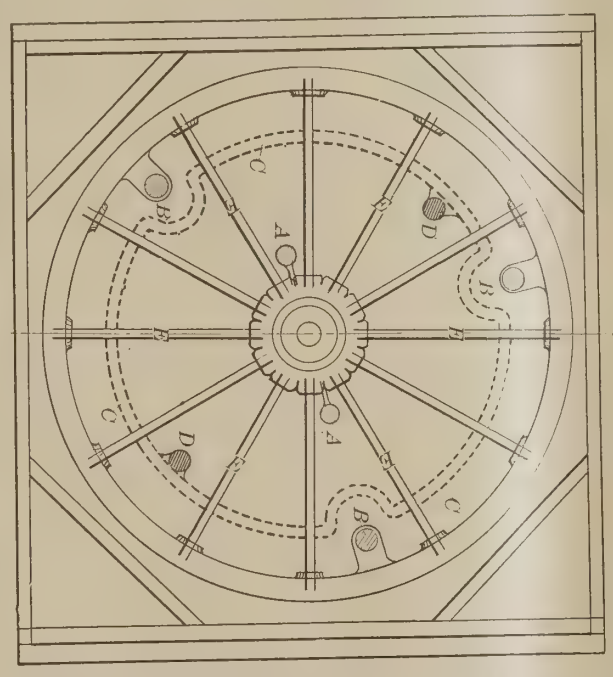
"Another important feature of the Exposition is that which shows how much the cost of steel has been cheapened. The reductions in prices of steel in this country have been made through the adoption of foreign processes, but steel is to be cheapened very much more. I saw steel made repeatedly from low-grade pig at a cost of $4 a ton. On account of the difference in the cost of labor we cannot do that here, but we can take the pig-iron of the South, costing, say, $8 a ton, and convert it into steel at a cost of $7 more. This process will be introduced here at once. I look for an unprecedented extension in the consumption of steel in this country. It will be produced at a price so low that it will be used in an almost infinite number of places not now thought of. The process of producing aluminum has reached a point where the metal costs only a dollar a pound. Should it reach the cost of steel, of which there is now a possibility, it will create a revolution in the arts. The world never gave such promise of producing wealth at so low a cost as it does now."

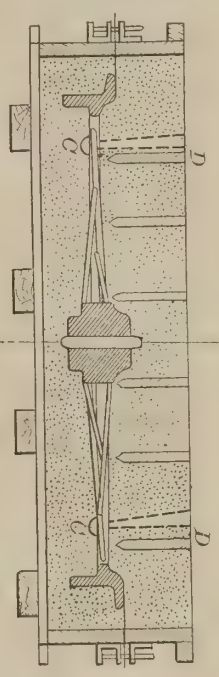
The method of steel production mentioned by Mr. Hewitt will soon be begun in this country by the Fox Solid Pressed Steel Company, of Chicago.

About Making Hand Car-Wheels.

Mr. L. C. Jewett, writing to the *American Machinist*, to which we are indebted for the annexed cuts, says: "Last winter I visited a jobbing foundry in the South, and among other work done was repairs for a railroad. After a pleasant talk with the proprietors, and a walk through the foundry, I noticed a few hand-car wheels in the collection of castings. "I see you make a few hand-car wheels," I said. "Well," responded the genial and good-natured proprietor, "you have expressed it the first time; we make a few and lose a good many. Just come out in the yard," he says, "and I will show you sadness." A great big heap of tangled and twisted sadness—he had not exaggerated the sadness part; it certainly was there, if about 50 or 100 hubs with crooked, kinked and battered wrought-iron arms, that the rims had been broken from, could give any evidence of hopes deferred. "What is the reason you don't cure that trouble and get sound hubs to your hand-car wheels?" "Well," said my entertainer, "you see there is no such thing as getting those hubs sound; the wrought-iron spokes in them prevents the hot fluid from laying still, and we pour the hub and rim both at the same time, too; we oil, chalk and red paint 'em, but they blow just the same, some worse than others, and these here are a specimen of the worst."

I said: "There is a way I have tried and others have tried, and we remember seeing but very few unsound hubs, if





followed. It is not new, but has been used in a few shops North and East, and here is the process:

"In the beginning the hub and rim should not be poured at the same time; by doing so the rim shrinks into the arms, and, both ends of arms being rigid, there must be a severe strain on the rim, sufficient to cause it to crack at a very slight blow."

"I have seen a section of rim come right out," said my interested friend.

"Now when you make your pattern you can have attached to the pattern arms a ring, as shown by the dotted line, so made that it will have room to set the gates necessary to run the rim, and these gates for hub marked *A A* and rim *B B*. If you have not many to make, the ring *C* can be cut with a gate cutter, after the pattern is drawn, being careful to cut gates below each print for wrought iron arms *E E*, etc.; when ramming up cope, you set two sprues for vent *D D*. These sprues answer a very important purpose, and are the *ne plus ultra* of the whole thing in providing means for the steam to escape as fast as made, so that it does not follow up the arm and condense on the end of them where they project into the hub mold, consequently you pour the rim from 15 to 20 minutes before pouring the hub, the latter I have known to be left out until the next day, and was then poured, and came as sound in the hub as a bullet.

"By this method the rim is relieved of strain, your hub is sound, and instead of a great big tangled up heap of sadness, as is now visible, there will be sunshine."

Says my friend: "I see into the whole thing. As fast as steam is made by the metal in the rim it gets into that ricket and *dare* go no further, only up out of the *vent*. Stranger, give me your hand, and we will go over here and talk about the new South and its future, and never say a blamed word about the late war."

The Cleveland, Cincinnati, Chicago & St. Louis has contracted for 4 complete passenger trains, which are to be put on and run as limited trains between St. Louis and New York City. The sleeping coaches will be built at the Wagner Car Works, and will be completed by Oct. 15.

Something about Timber.

Boards each 100 feet long and 6 feet in width would be a sight worth seeing, but piles made of such timber are common at the mills in Puget Sound, North Pacific. According to a traveler just returned from a visit to that coast, boards of those dimensions, and without a knot in them, are common cuts from the gigantic fir trees of the Puget Sound forests. These trees grow to the enormous height of 250 feet, and the forests are so vast that, although the sawmills have been ripping 500,000,000 feet of lumber out of them every year for ten years, the spaces made by these tremendous inroads seem no more than garden patches. Puget Sound has 1,800 miles of shore line, and all along this line, and extending thence on both sides, miles and miles farther than the eye can see, is one vast and almost unbroken forest of these enormous trees. There is nothing like it anywhere on the Pacific Coast. An official estimate places the amount of standing timber in that area at 500,000,000,000 feet, representing a constant supply for 1,000 years, even at the enormous rate the timber is now being felled and sawed. The timber belt covers 30,000,000 acres of Washington Territory, an area equal to the states of Vermont, Massachusetts, Connecticut and New Hampshire. The markets for the Puget Sound lumber are entirely foreign, being South America, Australia, Central America and the Pacific Coast islands.

The Car Starter Gone Abroad.

The street car starter has been about as much the object of patents as the car coupler, and hundreds of men have conceived that they saw fortunes in devices intended to transform the power required to stop a car into power available for putting it in motion. All sorts of mechanical contrivances were tried to store up the power, but a coiled spring was the greatest favorite. When the devices were subjected to the stern ordeal of hard work it was soon found their utility was not equal to the expense of application and maintenance. The invention appears just to have struck England, and its reception has been very cordial. The following notice from the *Practical Engineer* is similar to hundreds of notices that have appeared in American journals. But where are the car starters?

"Every time a tram-car is started from a state of rest—and this happens many times during every journey—a distressing strain is put upon the horses, which tells upon them and makes horseflesh a very heavy item of expenditure in tram-car service maintenance. Several unsuccessful attempts have been made to produce a mechanical contrivance which would assist the horses by imparting an initial motion to the car at the moment of starting. This is now satisfactorily accomplished by the tram-car starter of Messrs. Vereker & Yeates, which has been in use for the past six months on a car belonging to the Southwark & Deptford Tramway Company. The apparatus consists mainly of a coiled spring in connection with a clutch arrangement and a spud on the driver's platform. A simple movement of the driver's foot will throw the apparatus into or out of gear, and one revolution of the car wheels is sufficient to charge the spring for the purpose of restarting. On starting the car, the first forward movement of the horses causes tension on the traces and at once releases the spring, which, acting upon the wheels, causes the car to move gently forward several feet, the car, in fact, following the horses up. The apparatus, when being wound up, acts as a powerful brake; it can be used as an emergency brake, and can be operated from either end of the car."

A local paper informs us that there was so much gas escaping from wells near Steubenville, O., that the fires of the locomotives on a neighboring railroad had to be carefully banked while passing through the region of the escaping gas. We imagine that the fires must be very well banked indeed to prevent ignition of gas that is dense enough to take fire.

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EDITORIAL ANNOUNCEMENTS.

Advertisements.—*Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING COLUMNS. *The editorial department will contain our own views and opinions; and the rest of the reading matter, aside from advertisements, will be such as we consider of interest to our readers.*

Contributions.—*Articles relating to railway rolling stock construction and management, and kindred topics, by those who are practically acquainted with these subjects, are especially desired. Also early notices of changes in railroad officers, organizations and names of companies.*

Special Notice.—*As the* CAR AND LOCOMOTIVE BUILDER *is printed and ready for mailing on the last day of the month, advertisements, correspondence, etc., intended for insertion, must be received not later than the 25th day of each month.*

To Subscribers.—*We occasionally receive complaints from subscribers that their paper is not received regularly. When cause for such a complaint exists, the blame lies with the mails or with the method of delivery, for the paper is mailed regularly to every subscriber each month without mistake. Any subscriber who fails to receive his paper ought at once to notify the postmaster at the office of delivery. When a subscriber changes his address he ought to notify this office at once, so that the paper may be sent to the proper destination.*

The Need of an Improved Axle-Box.

A facetious individual who was present at a railroad club meeting last winter suggested as a subject of investigation and discussion the question, "Would it be possible to design a worse form of oil box than that which is now the standard of the Master Car-Builders' Asociation?" We have always entertained the opinion that a discussion of the question would have been more edifying than that which followed many of the subjects seriously introduced. It would be hard to find any component part of railroad rolling stock performing important functions, with so few merits to recommend it, as the car axle-box has got. A good axle-box ought to be large enough and strong enough to accommodate and hold parallel with the journal a brass of sufficient size to endure a long mileage; it ought to have an ample reservoir for oil or other lubricant, and made tight enough not to leak oil out or sand in; it should be so constructed that it could be packed easily and designed so that a brass could be applied or taken out without difficulty, and it ought to be durable and moderately cheap. The men who established the present axle-box as a standard appeared to place the element of excellence very low indeed, for the only merits that the box possesses are that it is cheap and that the brass can be easily changed. Probably the latter feature was what gave this form of box the negative popularity which led to its adoption by so many roads and prepared the way for its becoming a standard. There is every evidence that the box is one of the survivals of the crude age of railroading, when far more important than oil-saving or continuous exemption from heating were the attributes that permitted the thing to be roughly tumbled about without serious damage, and that enabled a brakeman to change a brass in five minutes. It is a survival of the period, not so very remote on some roads, when the fact that another box would run with one-fiftieth of the oil, and run ten times as long before a new brass was required, weighed as nothing in the balance compared with the drawbacks that a little skill and care were required in changing the brass, that a car inspector could not open it for inspection in three seconds, and that the original cost of the box was slightly higher. Many railroad companies, with progressive aspirations far in advance of crude practices, are likely for years to pay a heavy penalty for the legacy left them by past usage.

The establishing of standard parts of rolling stock has been of inestimable benefit to railroad companies in the interchange of cars; but the servility to standards is sometimes as expensive as carelessness about their adoption. A form that may be perfectly satisfactory under certain conditions of loads and of train service may, through changes introduced, become utterly out of date, and it is the duty of common sense to accept the inevitable and make the advances necessary. At the Master Car Builders' Convention of 1888 a very able report was submitted on "Journal Lubrication and the Best Practice for Economizing Oil," and the kernel of the report was to the effect that the proper way to use oil to good advantage and prevent waste was by using an oil-tight, dust-proof axle-box. At the last convention another committee reported on the same subject, and the conclusions were substantially the same. In neither case did the association make any practical use of the report. Whenever a suggestion for change, or a proposal calculated to effect improvement, comes up, the "established standard" presents itself like a Chinese wall, and intimates that the limit of progress has been reached. In this way a form becomes a tyrant, and men bow down and permit their ideas of progress passively to be trampled on by the inert idol of their own building. This "standard" idol should not be allowed to obstruct improvements, and men with a tendency to worship at that shrine ought to be careful that it is not leading them into digging a rut of routine so deep under their feet that they never will get out.

If it were not for the tyranny which the standard is exercising, there would be abundance of axle-boxes offered for use possessing all the merits required in a good box capable of giving the very best practice in economizing oil. Although inventors have been discouraged from laboring in this field, there are several patented boxes that would ensure perfect lubrication with the minimum expenditure of oil, but the influence that keeps other inventions out of the market has almost prohibited their application. The Bemis box has been repeatedly mentioned in the discussions on this subject, and excellent results have been obtained where it has been in service; but an insuperable barrier to the general adoption of this box is, that it requires a special form of journal. In the NATIONAL CAR AND LOCOMOTIVE BUILDER of July, 1887, we illustrated a "Dust-excluding Oil Box," designed by Mr. F. D. Adams, general master car builder of the Boston & Albany, the principal object of which, as explained by the inventor, was to keep out dust and grit and retain all the lubricants inside the box. The box is adapted either for journals with collars or without them, and it can be used without making any change on axle or journal. Boxes of this design have been in service now over two years with excellent results, one car having run 77,000 miles without having a change of brass. It would pay most railroad companies by preventing the delays from hot boxes alone, to throw away their old oil boxes and apply this one or one of equal merit that might be designed. We understand that several parties ordering cars lately have specified that the Adams box be used, and we consider the men who have taken this action deserve commendation for their courage in breaking away from the tyranny of the standard. It is high time that the Master Car Builders' Association was overhauling its standards with a view to making changes demanded by common sense.

Trying to Sustain Combustion by Incombustible Elements.

On some locomotives belonging to a railroad in Southern California they are trying an invention intended as an auxiliary to combustion, which is thus described by one of our correspondents: "Two three-quarter inch pipes are tapped into the nozzles, and each pipe is connected to one of the lower flues. At the fire-box end the flues are plugged, and through the plugs an opening is drilled at an angle which will project upon the surface of the fire the steam conveyed from the exhaust." Our correspondent says that there are conflicting opinions about the value of the device. We are not surprised at that, for there probably never was an attachment put on a locomotive about which there were not conflicting opinions. We are, however, very much surprised to find that a master mechanic was discovered in this year of grace, who was so ignorant of nature's laws that he applied the device described to a locomotive. Nearly all influential railroad officers are striving to encourage their enginemen to make themselves familiar with the principles of combustion, and on many of our best managed roads firemen are subjected to an examination before being put on the list for promotion, and to pass this examination they must show that they understand the elementary principles of combustion. They have learned that combustion is maintained by the gases in the fuel combining with the element oxygen that forms an important constituent of atmospheric air, and that from air must be obtained all the oxygen used for keeping the fire burning. If they have been in the habit of reading engineering literature, they would learn that steam has been repeatedly used with success for putting out fires in ships' holds, mines and other confined places, so the inference naturally is that it could not be a supporter of combustion. Yet a master mechanic, who is presumably selected for his superior knowledge, proceeds at considerable expense to apply to his locomotives the means of conveying this imbecile gas from the exhaust pipe to the fire, and evidently supposes that he is working in the direction of fuel saving. He might as well have plunged his head under water with the expectation of improving his health by drawing the water into his lungs.

Some men, who ought to know better, appear to think that because with some smoke-preventing devices, steam jets have been used successfully to inject currents of air upon the fire, that the steam itself must have a stimulating effect upon combustion, but it is a great mistake. If the heat should be sufficient to separate the constituent gases of steam, hydrogen and oxygen, so that the latter would combine with the fuel gases, the heat used up in tearing the gases asunder would exceed that which would be generated by the water gases becoming combustibles and promoters of combustion.

We have occasionally heard people say that the heating capacity of hydrogen acting as a fuel is so intense that it promotes economy to separate the gases of steam in a fire-box, but a little reflection will show that the operation is in line with the familiar example of a man trying to lift himself by his boot straps. Water in the form of steam is put into the fire-box, and supposing it is raised to the temperature at which the constituent gases separate from each other, the hydrogen will combine with the same proportion of oxygen that was separated from it and again unite to form water, the act of uniting causing intense heat. So the operation would be water converted into gas, and then the gas turned back into water. Like all other acts of heat phenomena, there must be considerable loss in the cycle of changes, and those who expect to gain anything by the operation are certain to be disappointed.

In ordinary practice, however, the water passed into the fire-box in the shape of steam or as moisture in the fuel does not experience the decomposition of its constituent elements. The steam merely becomes highly superheated, and passes off with the products of combustion as vapor. The quantity of fuel used in vaporizing the water in fuel or in raising steam passed into the fire-box to the temperature of the fire-box gases is utterly wasted. Steam from the exhaust pipe will be passed into the fire-box at about 270° Fahr. As the heat of an ordinary locomotive fire-box is generally over 2,000° Fahr., more than 1,300 heat units are wasted on every pound of steam passed into the fire-box. Water, of course, causes a still greater waste, as turning it into steam uses up a large amount of heat energy. If these considerations received a little more attention from practical men, the waste of heat which results from attempting to burn incombustible elements would be stopped.

Extend the Use of Driver Brakes.

When driver brakes began to be first applied to locomotives there was considerable prejudice against their use, as there has been against every new attachment put upon all other parts of railroad machinery, and a common manifestation of the opposition to driving brakes was the assertion that they damaged other parts of the engine. Among a few of the charges brought against driving-wheel brakes were, that they wore the driving box brasses rapidly, wore the wedge unevenly, forced the side rod brasses out of shape, and led to the breakage of driving boxes, side rods and crank pins, besides causing frequently flattening tires and generally accelerating the wear of tires. With these and many other charges ringing constantly against the use of driver brakes, they advanced rather slowly into popularity, and for years many railroad officers, who recognized the advantage of having braking power on driving wheels to help in stopping quickly when an emergency arose, earnestly opposed using driving-wheel brakes in making ordinary steps. The fault of any strictly emergency device is, that it is generally not ready when wanted. This made all emergency brakes that supplemented the use of hand brakes next to worthless, and it has made driver brakes, when used merely for emergencies, of no practical value. The brake may be in perfect working order, but when the man in charge is put suddenly in the face of an exciting emergency, he is likely to resort to the everyday methods of stopping, and forget to apply the power that has been reserved for a particularly quick stop. Ample proof has been abundantly furnished that this neglect of the emergency devices has repeatedly happened when the greatest necessity for quick stopping has arisen. Some of the worst accidents that have happened in late years would have been greatly mitigated had the driver brake been applied along with the train brake. By degrees one railroad company after another has introduced the use of the driver brake on all stops made by passenger trains, till the practice is now followed on nearly all roads operating fast trains; yet there still exists considerable prejudice against the practice. A little more skill and care is necessary in using the driver brake for all stops, but this ought to be no argument against the practice. An engineer who jerks the train every time he applies the driver brake is not a competent man.

We believe that the position taken by Mr. Howard in a paper read before the New York Railroad Club last year, that all wheels on a train ought to be braked, was perfectly sound, although we would prefer excepting the leading wheels of the locomotive, and the tendency of engineering opinion is in favor of providing the fullest possible power for stopping trains. That the leading railway master mechanics have accepted this inevitable result of mechanical progress was apparent from certain recommendations made by the committee of the Railway Master Mechanics' Association that reported at last convention on "Driver brakes," and from the manner in which the report was received. As the durability of the driving-wheel tires in nearly all cases regulates the time a locomotive can be kept at work before being taken in for repairs, the belief that the free use of driving brakes materially accelerated the wear of the tread of the tire was a strong argument with many master mechanics against the general use of such brakes; but the successful introduction of brake shoes that do their work on the parts of the tire that do not strike the rail has obviated that objection, and even made driving brakes desirable as a means of protracting the mileage of engines between the periods of tire-turning.

In view of the recommendations of the committee on driver brakes and the increase of information on the sub-

ject, there were some exceedingly antiquated views expressed in the discussion that arose on the report. The expression of a hypothesis that the breaking of a crank pin was due to the application of the driver brake when a wedge happened to be down, brought out nearly all the ancient objections to the use of driver brakes. Locomotives that are permitted to run with their wedges down and their side rods out of tram, are very liable to have broken crank pins and broken rods; but we do not think it is fair to attribute the resulting damage to the power transmitted through brake levers. There are much more powerful forces acting upon the connecting parts when an engine is running at high speed. It would be a very weak rod or pin that would break under the strains transmitted through driver brakes. As far as we have been able to judge, engines without driver brakes meet with as many accidents to rods and crank pins as those that have brakes. Where great care is bestowed upon keeping wedges properly adjusted and the side rods in tram, accidents to crank pins and their connections are very rare. We never knew of an accident of this kind happening where it could not be traced to carelessness, and it is not a wise way for men in charge of motive power to talk up far fetched theories to explain accidents that have a perfectly natural solution. Trains are becoming heavier every year, their speed is increasing, and the number of trains per mile of track constantly grows greater, yet the stationary facilities for handling them safely receive little attention. The means of stopping the trains in the shortest possible distance is every day becoming more urgent as a measure of safety, and the only improvement that can be made, besides the general introduction of power brakes on freight cars, is the general adoption of driver brakes operated in unison with the train brake.

Demand for Heavy Freight Cars in Europe.

The New York Iron Car Company, which handle the well-known tubular iron car, have been running cars of their type in different parts of Europe, and the extraordinarily heavy paying load carried in relation to the dead weight appears to be making many converts in favor of larger cars for the transportation of heavy freight. The car commonly used on European railways for freight purposes weighs about five tons and carries about the same weight of load. The iron cars carry from 30 to 40 tons, and the dead weight is only about 30 per cent. of the load. This tells very materially on the expense of moving heavy freight, such as coal and iron, and the companies that have tried the iron cars have received an object lesson on methods of reducing the expense of transportation which is likely to lead to a revolution in the design of freight cars. Some of the English railways have introduced a considerable number of iron tubular cars for carrying heavy freight, and are increasing this kind of rolling stock rapidly. The desire to reap part of the benefit to be derived from the use of heavy cars has now extended to Germany, and public meetings have been held to give those interested the opportunity ofi mpressing their sentiments upon the government bureau in charge of railroads. Resolutions were passed requesting the German railroad authorities to introduce heavy freight cars, and the following is part of the "argument" used:

In the United States and in England there are running at the present time freight cars of special construction with tubes which have a carrying capacity of 30 to 40 tons, with a dead weight of 30 per cent. of the carrying capacity; they are, moreover, constructed with arrangements which, by quickly unloading through the floor openings, both render the unloading cheap and reduce the time required to a minimum. A comparison of the tare and net weight of these cars with those in use by us for heavy goods shows that transportation in the cars of greater carrying capacity can be effected at considerably less cost. Furthermore, the dispatch of heavy goods does not generally take place in single wagon loads; by far the greater percentage goes from establishments which use daily five wagons for loading. To these establishments and to the receiver it is a matter of indifference whether the unit of the carload amounts to 10, 20, or 30 tons. The larger cars would lead to smaller outlay, both for the railway companies and the senders of goods, and consequently to lower rates. The use of these cars would be a considerable improvement both on account of the more favorable conditions in regard to weight and the greater rapidity of unloading, and it would remain to be ascertained whether the rolling stock would have to be provided in the same proportions as would be necessary if we retained our present cars. The arrangements required at the unloading stations to permit of using cars with floor flaps will be willingly borne by the receivers if, with an unloading delay reduced to two or three hours, they are compensated by a participation in the saving of the costs of dispatch. The actual unloading under the circumstances will be reduced to minutes, and further detention at the unloading stations only be required for shunting and re-formation of the train.

"The much smaller number of cars which, with such a system of loading, will in future be required for goods trains, and will, moreover, permit of greater speed, and far heavier loads for the trains in comparison with the present net capacity. There would, therefore, be a far greater utilization of the rolling stock, and of the services of the employés. Moreover, it would be possible to handle a far greater quantity of freight at the existing railway depots than is the case at present. And it is well known that many frontier railway stations have already reached the limits of their capacity and require for the present wagons costly reconstruction."

Poor's Manual of Railroads.

A few days before going to press we received the twenty-second annual number of the above publication. The volume is arranged in the usual way, and contains a vast amount of information that is of the greatest value to railroad officials and to all business men interested in railroad property. The statistical information given in the work is surprising alike for its extent and its accuracy. The publishers of the directory have this year incorporated in the volume Poor's Directory of Railway Officials and Railway Directors, which formerly was published as a separate book. This part of the work contains the name and address of nearly every official that business men would be interested in finding. The leading officers are first given together under the names of the railroads to which they belong, then the general officers, the chief engineers, the master car builders, master mechanics and purchasing agents are arranged in separate departments. This will be very convenient for business men who are looking for the addresses of one line of railroad officers.

According to the Manual, the total number of miles of railroads in the United States at the close of 1888 was 156,082, of which 7,028 miles were built during the year. The number of locomotives in service was 29,398, passenger cars, 28,252; freight cars, 1,005,116. This is an increase during the year of 1,548 locomotives, 1,388 passenger cars and 48,485 freight cars.

In the Dominion of Canada there are reported to be 12,701 miles in operation, on which there are 1,657 locomotives, 1,912 passenger cars and 44,009 freight cars.

We have repeatedly alluded to the work that a committee, belonging to the American Society of Civil Engineers, was performing in investigating the proper relation to each other of the sections of wheels and rails. We published about a year ago those portions of the preliminary report made by this committee that were likely to interest our readers. The final report of the committee has now been published. The portion of the report that is of most interest to rolling-stock offices, says that "the prevailing sentiment appears to be that the end sought in the suggestion of an entirely flat top between the rounded corners, viz., a wider bearing for the wheel-tread, is a desirable one; but that it is and will be better secured in practice by using a slight curve for the top of the section, instead of a straight line. The evidence is that an entirely flat top is difficult, if not impossible, to roll properly. Inevitable irregularities of track and the usual slight bends in the web, due to the rails lying on their sides when hot, would throw the bearing of the wheel-tread on one or the other corner instead of evenly across the top, causing early flowage and rounding of section. The standard wheel-tread is now slightly coned, a perfectly cylindrical tread having first been rejected. Were the tread originally perfectly cylindrical, with an even bearing for the whole width of rail head, the necessary gauge play alone would tend to wear it hollow. Under existing conditions wheel-treads wear slightly hollow, corresponding to about a 12-inch radius, very early in their lives. As a consequence, nearly all rails now wear down to a curved top on the outside as well as the inside of the head. With the top curve the load is sustained centrally and transmitted directly downward throught the web. Without it, one or the other corner will sustain the load in practice, and neither long in succession, causing a tendency to split off the side of the head if the metal be in any way defective. Most wheels being worn slightly hollow, the bearing is in practice now tolerably wide. If there were no other difficulty or objection, there is the great practical one that it would be a herculean task to unite the railways of the country in two simultaneous and decided changes of practice. Were this task achieved, there would inevitably be a long period of transition, during which our last state would be worse than the first. For all these reasons, your committee is entirely clear that the attempt to introduce a perfectly flat top is inexpedient.

The *Railway Engineer* of London, publishes every month reports on railway accidents made by inspectors appointed by the British government to investigate all accidents and report on how they happened. The reports are admirably compiled, and show very clearly where the blame rests for every accident that happens. The officers making the investigations are experts in the business, and no interested official can deceive them as to who or what was at fault. It would be an excellent plan if our Interstate Commerce Commissioners would appoint similar officers to report on accidents that happen to our trains. Their services would be of the greatest value, not only to the traveling public, but to railroad companies also, at least to railroad companies that are trying to perform their business in a safe and proper manner. The great majority of railroad accidents happen through gross carelessness of some person, and the man really at fault often escapes just censure or punishment by putting the blame upon others. An inspector accustomed to the business would quickly get at the exact facts, and his impartial reports would be calculated to make responsible men more careful. The clear, unambiguous light thrown upon accidents by the report of an expert would also make railroad companies a little more anxious to avoid the publicity that such reports would give; and he could put pressure upon those who were the greatest transgressors that would be of very great benefit to the public and to railroad men themselves. The principal shareholders of one of our leading railroads are said to be engaged on the operation of freezing out the president because he has gone to unusual expense introducing safe equipment and safety appliances. People of that kind need the work of a government inspector to find out where the real blame for accidents rests.

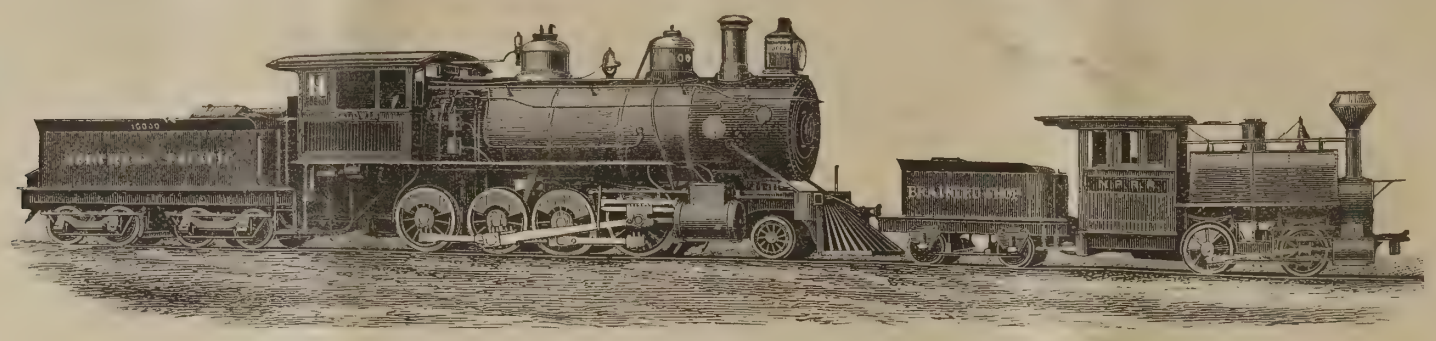
There appears to be very good prospects of a great exhibition being held in New York in 1892 to commemorate the discovery of America by Columbus. The business men of several leading cities are making efforts to have the exhibition held in the city where their interests lie, but it looks as if New York would be the place decided upon. A very influential committee has been appointed by Mayor Grant, of New York, to organize the proposed exhibition, and the members have held several meetings and proceeded vigorously to work up the enterprise. The appointments have given general satisfaction, and the men who are thus called upon to take the lead are certain to achieve success. Among the appointments that will interest our readers are:

Mechanical Engineers, Henry R. Towne; *Civil Engineers*, John Bogart; *Elevated and Suburban Rapid Transit Roads*, Jay Gould; *Express and Freight Transportation Companies*, Thomas C. Platt; *Iron*, Abram S. Hewitt; *Machinery and Railroad Equipments and Supplies*, Charles A. Moore; *Railroads*, Chauncey M. Depew; *Scientific and Educational Interests*, Charles F. Chandler; *Street Railroads*, Cornelius Vanderbilt.

On being asked by Mr. L. F. Lyne if they ever applied an indicator to the locomotives they built, the chief officer of a locomotive building company is reported to have answered that they built locomotives to pull cars, not to pull indicators. The spirit of ignorant egotism displayed in the answer is happily rare among our locomotive builders, who have proved themselves an intelligent class of business men, ever ready to adopt progressive ideas and every improvement that would show what their engines were capable of doing. Several builders have dropped out of the bnsiness of making locomotives lately, principally because they persisted in ignoring progressive ideas, and tried to continue building locomotives as the work was done half a century ago. Several who are still running their works are destined to close before many years or adopt new methods. The chances are that the man who sneered at the use of the indicator will lead his company out of the business if he lives long enough to work out the natural end of his ideas.

In another page will be found the first of a series of articles on "Compound Locomotives," by Arthur T. Woods, Professor of Engineering at Illinois State University, Champaign, Ill. The subject of compound locomotives is becoming of living interest to American railroad men, and there is already a demand for a text-book for the instruction and guidance of designers. Professor Woods has made the subject of compound locomotives a special study ever since engines of that kind were first introduced, and he is eminently capable of producing articles that will give exact data to designers and interesting information to the general reader. We believe that Professor Woods' articles will prove highly seasonable in view of the popular attention compound locomotives are receiving, and that they will be the means of spreading reliable information on a difficult mechanical subject which is yet very imperfectly understood.

The St. Gothard Railway Company have ordered for heavy mountain service a Mallet compound locomotive to be built by a firm in Germany. The engine will be mounted on six axles, coupled in two independent groups with two cylinders each, the high-pressure cylinders being fixed to the hind part of the main frames, while the low-pressure cylinders are mounted on a front bogie. As this tank engine will weigh, empty, 64 tons, and fully equipped for service about 85 tons, it will, in fact, be the heaviest locomotive constructed up to the present in Europe. Mr. Mallet, after whose designs this powerful engine will be built, is really the father of the compound locomotive, and many of his engines running in France are among the most successful locomotives doing work. The engines are all provided with the means of using high-pressure steam in the low-pressure cylinder while starting trains or during slow pulls on steep grades.



THE FIRST AND LATEST NORTHERN PACIFIC LOCOMOTIVES.

Personal.

Mr. Louis C. Gable, master mechanic of the Chesapeake, Ohio & Southwestern at Paducah, Ky., died in that place this week of heart failure.

Mr. Allen Manvel, general manager of the St. Paul, Minneapolis & Manitoba, has resigned to accept the position of president of the Atchison, Topeka & Santa Fé system.

Mr. I. W. Fowle, for several years master mechanic of the Cincinnati, New Orleans & Texas Pacific, at Meridian, Miss., has been appointed master mechanic of the Colorado Midland, at Leadville, Col.

Mr. Charles A. Moore, of the firm of Manning, Maxwell & Moore, New York, has been appointed on the committee of the New York 1892 Exhibition, as representative of railway machinery and supply interests.

Mr. J. Bradt, after a service of more than thirty years with the Erie, has resigned as master mechanic of Hornellsville Division. It is understood that Mr. Bradt intends to retire permanently from railroad business.

Mr. William Wilson, late of the Chicago & Alton, and known as one of the ablest mechanics and inventors in this country, is living at Bloomington, Ill. He is ready to enter railroad service again when a fitting opportunity offers.

Mr. Charles Murray, superintendent of the Galena division of the Chicago & Northwestern, an old and highly popular officer, died at his home in Oak Park, near Chicago, Sunday, July 28. The funeral was held at Oak Park, July 30, and was attended by several hundred of the employés of the Galena division.

After protracted rumors that a change was pending, Mr. William B. Strong, president of the Atchison, Topeka & Santa Fé, has resigned. Mr. Strong is undoubtedly one of the ablest railroad men living, but he could not make earnings out of proportion to the business, and on this account he ceased to be in sympathy with the owners of the Santa Fé system.

Mr. Charles Blackwell has been appointed assistant superintendent of the Toledo, St. Louis & Kansas City Railroad, with general supervision of the mechanical department and train service. This is a position which Mr. Blackwell is eminently fitted to fill successfully, for he has had a varied experience in both departments. As a mechanical engineer and locomotive designer he has few equals.

The Western New York & Pennsylvania has lost the services of a most able general superintendent by the resignation of Mr. George H. Gatchell. Mr. Gatchell's first service on this road was in 1866, when it was the Buffalo, New York & Philadelphia. He entered its employ as a rod man, and in 1867 became assistant engineer. He later held the same position on the Rochester & State Line and the Chicago & West Michigan roads. He returned to the Buffalo, New York & Philadelphia in 1870 as assistant engineer. He has since been chief engineer for five years, and general superintendent since 1879.

Mr. H. M. Britton, general manager of the Rome, Watertown & Ogdensburg, died at his home in Oswego, N. Y., last month, of heart disease. Mr. Britton has been in delicate health for some years, and he went to Paris to consult with noted physicians there, but he received no benefit from the treatment recommended. Mr. Britton was for years regarded as a leader in the railroad mechanical world, and he was the first president of the American Railway Master Mechanics' Association, an office which he held for nine years. He began railroad work as an apprentice in the machine shops of the Fitchburg road and rose there to be master mechanic.

President Richards has sent out the announcement that commencing Sept. 11 the New England Railroad Club will hold their meetings on the second Wednesday of the month at the United States Hotel, Beach street, Boston.

The annexed engraving gives a striking illustration of the first small locomotive that the Northern Pacific Railway Company were owners of, in front of the magnificent and massive-looking consolidation, which is the latest purchase of the company, the latter engine having the distinguishing note of being No. 10,000 built by the Baldwin Locomotive Works. Mr. W. T. Small, Superintendent of Motive Power of the Northern Pacific, writing about the small locomotive, says:

"This engine, with a sister engine, furnished the power for laying the track between Duluth and Brainerd; the other two were sent to Puget Sound about 1870, and were used in laying the track in constructing the road between Kalima and Tacoma, and were still continued in service up to 1886, when they were sold to a logging camp, and are now used in hauling logs out of timber to river banks. After making a big discount for all that has been said about these small engines, and from what I saw of them myself, I must say they have rendered remarkably good services for their inches. They are of the Smith & Porter build and were received on our road August, 1870. We now have one in service at our Brainerd shops used in moving engines and tenders and cars from place to place, and it was suggested some months ago that it be disposed of, but the master mechanic made such big objections that we concluded to keep the engine in service. I think he would as soon have had us remove two of his 10-wheel passenger engines that we have lately received as to take this one from him; at least he acted in that way, and the engine is to-day in service, and I think will so remain."

The consolidation engine weighs 150,000 pounds in working order, of which 135,000 pounds are on the drivers. The cylinders are 22 × 28 inches, and the driving wheels are 50 inches diameter. With a boiler pressure of 140 pounds to the square inch, the engine is capable of exerting a pull over 34,000 pounds on the draw-bar. The engine is used on grades of 116 feet to the mile, with 10 degree reverse curves, and she has pulled up a load of 20 cars weighing 600 tons.

The boiler is made of ⅝-inch steel, is 72 inches in diameter, and its center line stands 7 feet 8 inches above the rail. The fire-box is 10 feet 1 inch long by 42⅝ inches wide inside. There are 271 flues 2¼ inches diameter and 13 feet 6 inches inches long, giving 2,121 square feet of heating surface. The fire-box provides 172 square feet of heating surface, and the whole makes a total heating surface of 2,293 square feet.

The two locomotives present a fair parallel between the past and the present of the company to which they belong.

A Novelty in Locomotion.

A hydraulic railway, whose working is more minutely described in an article that appears on another page, is one of the greatest novelties that attracts attention of visitors to the Paris exhibition. The railway is the invention of Girard, a French engineer of note, who was killed in the Franco-Prussian war, and is now put into working order by one of the inventor's assistants. The purpose of the hydraulic railway is to transport people at a much higher speed than has been found practicable with ordinary methods of locomotion, and although the railway on exhibition is only about 200 yards long, the speed capabilities appear to be extraordinary, a rate over 100 miles per hour having been made.

The trains have no locomotives and the carriages no wheels. The carriages are supported on broad rails, raised some distance from the ground on metal blocks. The rails and carriage supports correspond to the planed slides and guides in steam engines, and before starting water under high pressure is forced between the sliding supporting pieces, the rails thus bearing up the carriages on a water film and preventing the supports from resting directly upon the rails. The whole weight of the train is thus supported on water films, and the friction is not that due to two solids, but to liquid surfaces. The motive power is supplied in a manner quite as novel.

Along the center of the track is laid a water-supply pipe into which water is pumped at great pressure, and all along the track a series of discharge nozzles point in the required direction of movement. When the train is started one or two of these nozzles discharge water, which strikes against projections under the carriages and forces them on. As the train moves taps are opened, so that at regular intervals new impulses are received from the issuing jets. As the carriages pass, the valves or traps close again, so that at any particular time only those under the train are in action for propelling. The train thus receives its motive power from the force of the water jets striking the projecting surfaces under the carriages.

The system is extremely interesting, but we fail to see any advance over the present railways with locomotives. Apart altogether from the wasteful mode of applying water-power by impact, the hydraulic system of transmitting power through pipes is incapable of economical transmission for long distances, such as those on our railways, and enormous powers would require to be generated at the pumping stations to give even a small power at the carriages say 100 miles off. The expense, too, would be very great even for short distances.

Families of Employes Traveling Free.

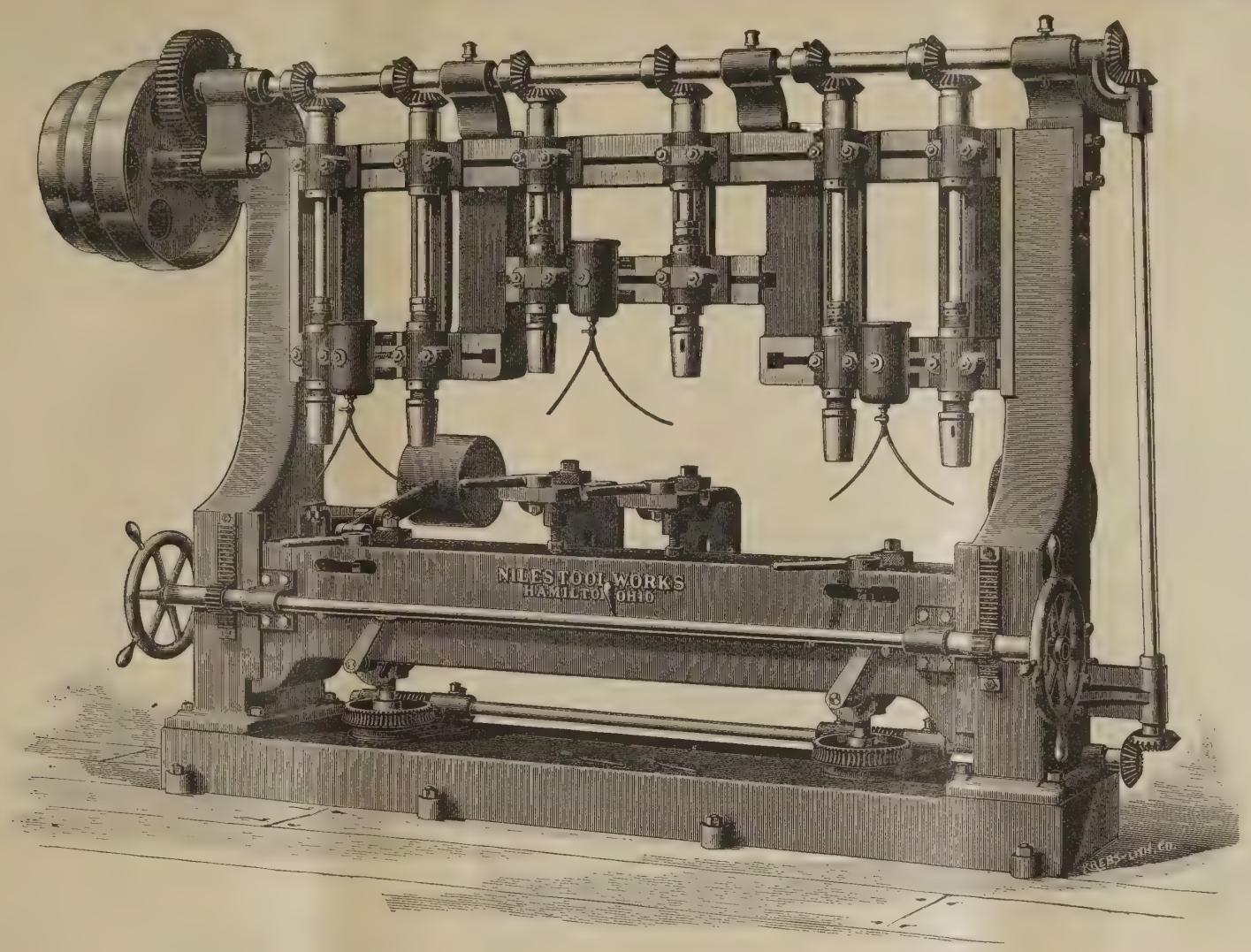
In our last issue we commented on the action of one John Livingston calling himself President of the "Railway Stockholders' Association," who entered a complaint with the Inter-state Commerce Commission against certain railroad companies for carrying locomotive engineers to conventions free of charge. "General Manager," writing in the *Railway Age*, throws considerable light on this John Livingston and his ways. The writer says:

I observe in your paper, copy of the complaint against sixty-one railroads, "of whom we are which," for carrying brotherhood men and their wives or other members of their families free.

The complaint is not susceptible of verification in many respects. The Brotherhood of Locomotive Engineers, which has been in existence in this country since 1865, is not a secret society in any such sense as might be applied to the Odd Fellows, Masons and other similar societies. I have watched the practical working of the Brotherhood, and I have no hesitation in saying it has been very useful in elevating the character and the personal habits of the locomotive engineers in this country. Moreover, there have been very few strikes during the 23 years since the establishment of that organization. No business between the locomotive engineers and the railroads which employ them has been attempted to be transacted in secret session. All grievances, complaints or disagreements between the engineers and the railroad officers have been settled openly through a committee of engineers, or through the assistance of Mr. Arthur, the grand chief engineer, and the railroad officials themselves, and the statement that they are a secret society is untrue. I do not happen to have the pleasure of the personal acquaintance of Mr. John Livingston, but I do know that for several years past, on account of his advertised position as President of the "Railway Shareholders' Association," he has obtained annual passes over many of the railroads of the United States. This year, I think, he has been less successful in that regard. If the Brotherhood is a secret society, why did Mr. Livingston address a communication to the meeting at Richmond, Va., and why did he propose to the Brotherhood that he would intercede in their behalf with the C., B. & Q. road, provided they would pay him a certain amount of money? Mr. Livingston's proposition was promptly declined by the Brotherhood. Mr. Livingston seems to be inclined to turn an honest penny at any and all times, hence he offered his services to the C., B. & Q. road as a mediator between that company and the Brotherhood, but at much higher figures.

It has been a custom with railroad companies for twenty years past to allow delegates to the following meetings to take their wives, or some members of their families, with them, viz.: Master Mechanics' Association, Master Car Builders' Association, Train Dispatchers' Association, Passenger Conductors' Association, Roadmasters' Association, Brotherhood of Locomotive Engineers, etc. No free passes are generally issued by any of the railroads, but it is understood and orders are always given to carry these delegates and their wives, or some other member of their families, free, on presentation of proper credentials. These annual meetings are about the only vacations that such railroad officers and employés ever obtain. Moreover, these meetings are of great concern and great importance to the railroad companies themselves.

There is another instance where the law is violated, if Mr. Livingston's position is correct. Railroad employés in this country in destitute circumstances are killed almost daily, and, as a matter of humanity and propriety, it is frequently found necessary to send the remains to some other State to be buried. The railroad on which the unfortunate man has lost his life makes application to its connecting roads for free transportation for the members of the family of the deceased and those who are obliged to attend the funeral. This custom has also been going on for years past, and is going on to-day, and ought to continue to go on. If Senator Reagan and Senator Cullom intended when the law was passed by Congress that in "regulating commerce among the States," every railroad should be debarred from doing a charitable or a humane act, or a respectable act, with reference to its employés, why didn't they show it in the law?



ARCH BAR DRILL, SIX OR EIGHT SPINDLES.

The machine illustrated herewith is designed for drilling car truck frames, and is built by the Niles Tool Works, of Hamilton, Ohio.

The special features in its construction are its weight and strength and the conveniences provided for setting work and operating the drill. The driving cone has three steps of large diameter for 4-inch belt and is strongly geared. The spindles are driven by cut bevels.

The outer spindles have an adjustment from 7½ to 18 inches between centers and the inner spindles an adjustment of from 6¾ to 22 inches. Each spindle has a vertical adjustment allowing the drivers to be used at different levels.

The feed is to the table, which is also counter-weighted. The feed is operated at both ends, carrying the table square up to its work. Convenient devices are provided for setting and clamping work.

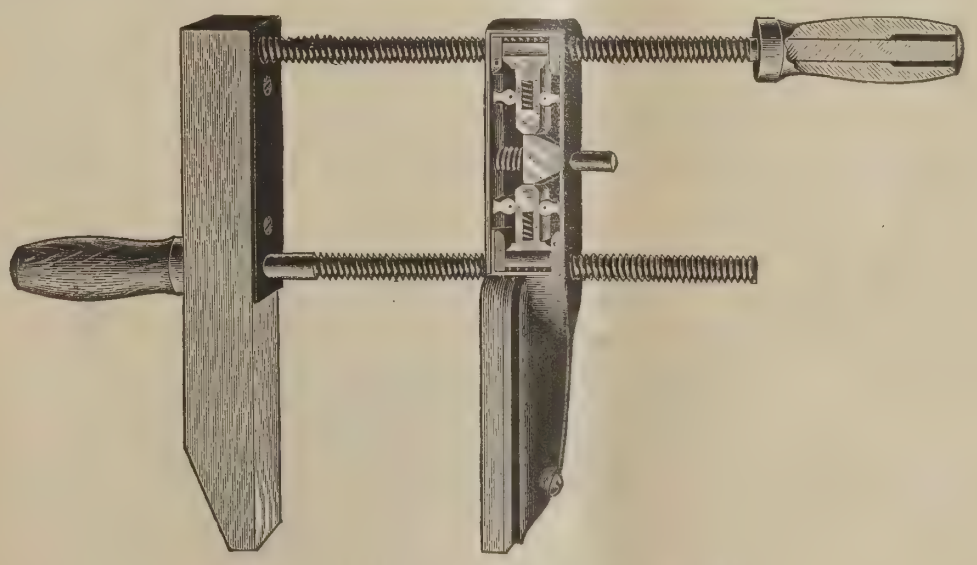
The machine can be furnished with 6 or 8 spindles, as may be desired. For futher information and photographs, address Niles Tool Works, Hamilton, Ohio, or at the branch offices in New York, Philadelphia, Pittsburgh and Chicago.

The steamer "City of Paris," which has lately made the fastest run across the Atlantic ever accomplished, has engine and propeller bearings of Magnolia metal, and a portion of the great speed maintained is said to be due to the reduced friction of the metal named. This metal is becoming very popular for all kinds of bearings that are hard to keep cool.

The Westinghouse Air Brake Company have issued a circular announcing material reduction in the price of air-brake apparatus. Plain pipes and pipe fittings will in future be omitted from the list of material. The new prices, without pipe, will be: For a locomotive, $275; for a passenger car, $100, and for a freight car, $45. For pneumatic signal fixtures the prices are: For engines, $30, and for cars, $15. The actual net reductions, after allowing for pipe and fittings, are about 7 per cent. on engines, 23 per cent. on passenger cars, and 4 per cent. on freight cars. The price of tender fixtures, $60, remains unchanged. The apparatus for operating all the wheels of a 12-wheeled car costs $120. Air pumps have been reduced from $200 to $125, and hose couplings from $5 to $2.50. The announcement is accompanied by an explanation of the increased cost and value of the material now furnished, as compared with older patterns, especially that for locomotives and freight cars. The quick action freight brake fixtures cost about 20 per cent. more than the original patterns, and the reduction is only made possible by the extensive plans and resources of the company and the confidence it has in the future expansion of business. The consistent aim of the company has been to constantly improve the brake, keeping it abreast of the demands made upon it, and to make all changes and improvements without interfering with brakes in use or with the principle of uniformity, or making any trouble for the users. Ten million dollars has been invested in Westinghouse automatic brakes in this country, and the company has yet to hear of an apparatus that have been worn out, so that this large investment stands to-day worth its full cost price. The prices now charged for material are so closely governed by the cost of manufacture that anything like a royalty charge has practically disappeared.

Tri-sodium phosphate, a chemical product handled by the Keystone Chemical Company, Philadelphia, is said to be very effective as a preventative of the formation of scale in steam boilers. An analytical chemist, writing about the compound, says: "And, after making numerous experiments with it, I have arrived at the conclusion that it furnishes the best and most effective means for separating such constituents of the water as cause the formation of scales and incrustations in boilers. These constituents are converted into light flocculent precipitates which do not deposit as scales or incrustations, but remain suspended in the water and can easily be removed by blowing off. Waters containing lime, magnesia, etc., as bi-carbonates or sulphates, and silica, are at once deprived of these injurious constituents when boiled with the proper quantity of tri-sodium phosphate. Another important property of this salt is that it does not only act upon the injurious substances dissolved in the water, but even upon scales and incrustations already existing in the boilers, which are gradually removed by it; because it acts upon the solid carbonates of lime and magnesia, as well as upon the sulphate of lime, even in its anhydrous form (one of the worst kind of boiler incrustations) by converting them into pulverulent and flocculent phosphates. As it has no injurious effect upon the boilers, the use of this salt for the purposes indicated is of great importance.

The Diamond Machine Company, of Providence, R. I., have recently added to their factory about 20,000 feet of floor room, which they are fitting up with the latest and most improved machinery, that they may be able to supply the increasing demands of the trade for their grinding and polishing machinery. They are now making large shipments abroad to the foreign trade, and report greatly increased demands. They have also moved into large new double offices at their factory. The Chicago offices, new quarters, corner Washington and South Canal streets, is one of the largest and best situated in that city for the display of their machinery, polishers and nickel platers, supplies and sundries. They have reports of greatly increased sales from this office, and have been compelled to move into these new quarters to enable them to meet the demands of their Western customers. They trust, with their greatly increased facilities, to be able to fill all orders promptly for their regular line of grinding and polishing machinery.



CHENEY'S RAPID ADJUSTING HAND SCREW.

In sending us Cheney's patent rapid adjusting hand screw for illustration, the Capitol Manufacturing Company, of Chicago, says:

In presenting this new tool to the trade and users, we have departed from the old and slow methods heretofore employed, and constructed a tool which is bound to be recognized as a vast improvement over any existing hand screw now in use.

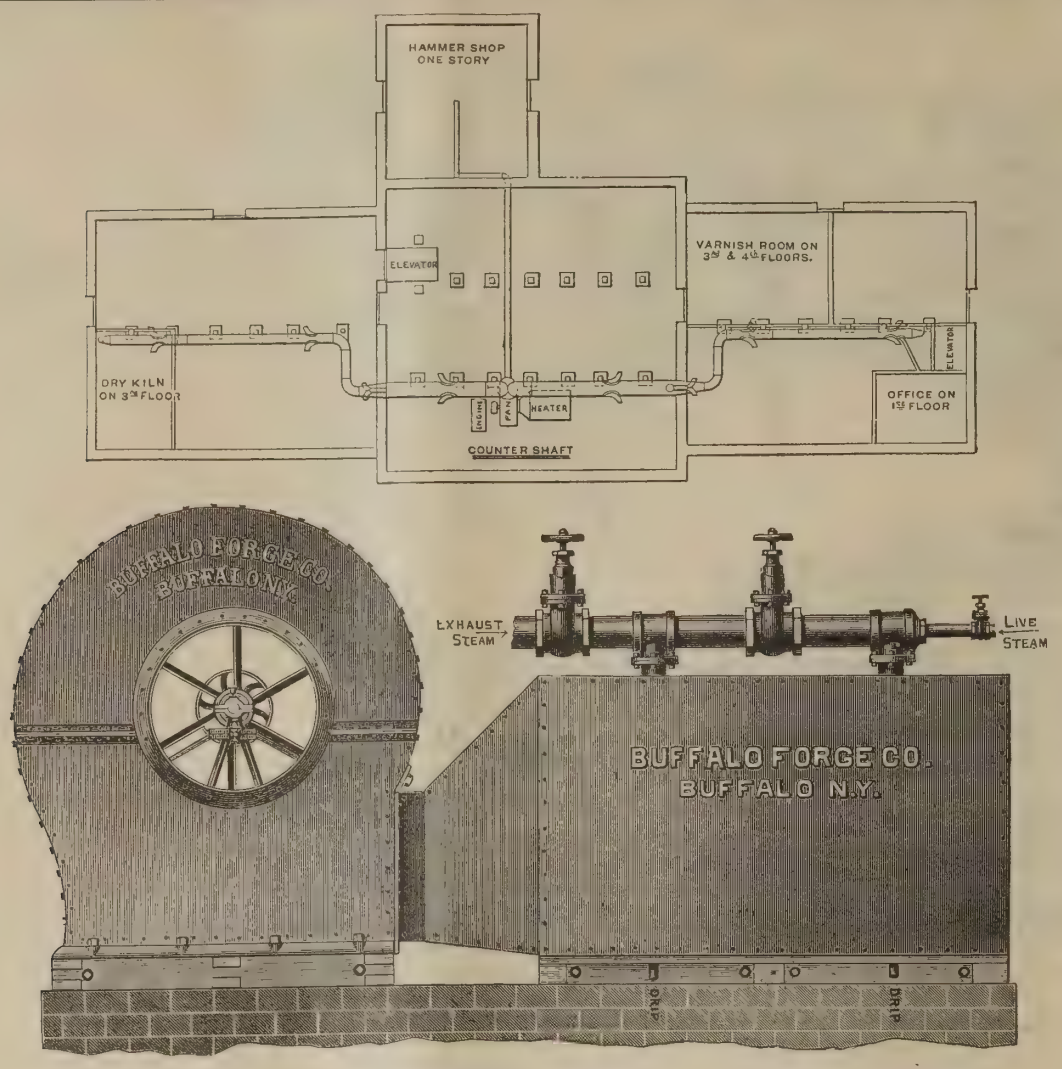
The hand screws universally in use at the present time are the same in principle as those used years ago, and while great changes and developments have been made on most all of the tools used by skilled mechanics, leading toward an economical employment of time, it seems as though this much used and indispensable tool has been entirely neglected.

It has been our aim to produce a hand screw which meets all the modern requirements as to strength, durability and economy of labor. The upper jaw is made of iron, faced with wood where it comes in contact with the material to be clamped, to prevent its being marred. This jaw is very strong and is made partly hollow, and contains the mechanism for adjusting instantaneously the upper to the lower jaw without turning the screws, which are only used for tightening clamps after they are adjusted. The mechanism is plain and effective, and there is nothing to get out of order. The screws are made of wrought-iron, and are fastened to the jaws in such a way as to prevent their coming apart, which is a very frequent and annoying occurrence with the common hand screws.

The lower jaw is made of hard wood, thoroughly seasoned and dry, and there is only one smooth hole penetrating the wood, which in no way impairs the strength of the jaw, while in the common hand screws two-threaded holes go through the wood, thus weakening the same materially. The construction of our hand screw guarantees a parallel movement of the jaws. No mechanic can afford to spend his time on the old style hand screw, constantly breaking or getting out of order, when he can have a perfect tool of instantaneous adjustment made to last a lifetime. The workmanship, finish and material is the best that can be secured, and the price very moderate. We manufacture these hand screws in all sizes from 6 to 20 inches.

We also manufacture clamps on the same principle made entirely of iron, where desired, for use in machine shops and foundries, for clamping together molding flasks, and thus supplying a long needed appliance for such purposes.

Write for prices and discounts.



THE HOT-BLAST SYSTEM OF WARMING FACTORIES, MILLS AND WORKSHOPS.

The system of heating workshops and large buildings by a mechanical circulation of hot air known as the indirect radiation or hot blast system, has of late years been attracting the attention of owners and builders either by the result of their own observation, or by the indorsement of authorities in such matters who have instituted comparisons which have satisfied them of its advantages as compared with any other method of heating large buildings now employed.

We illustrate herewith diagrams in ground plan showing the practical application of this system to a wagon factory in Binghamton, N. Y.

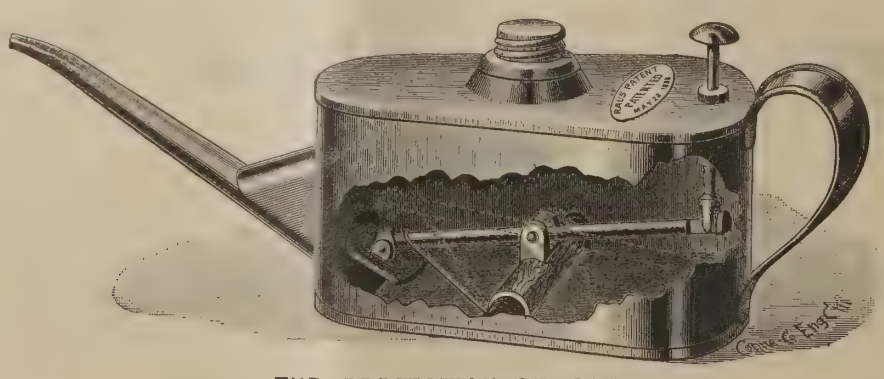
It will be seen that the apparatus consists of a blower and heater combined. The steam is conducted through the pipes of the heater, through which the air is blown and the heated air is then passed through ducts to all parts of the building. The manufacturers claim to have the indorsement of engineers and architects who have had opportunities for observing its practical operation in all the items which go to make up the superiority of a heating plant, viz., economy of first cost and maintenance, uniformity, ease of positive regulation, reduced space, cleanliness, convenience, and abatement of fire risk.

Moreover, the different rooms, albeit requiring different degrees of temperature, are heated uniformly in every part, as the warm air is forced to the most remote corners in every part of the building, differing in this regard with the ordinary method of steam heating by direct radiation, which, while producing a comfortable and often an oppressive inert heat in the immediate vicinity of a radiator, communicates warmth to the surrounding air slowly, involving an excessive consumption of fuel and time before the apartment is uniformly warmed.

Not least among the practical advantages claimed for this system are its compact form and the ease with which its operation is under perfect control of the attendant, who, without leaving the boiler-room, can maintain any desired temperature throughout the building without interfering with his other duties. There are no incessant packing of valve stems and repairing of leaky pipes and joints in unexpected and most undesirable places, as any possible defect of this kind is confined to the space occupied by the heater, and is immediately detected and remedied. The reduced fire risk is also in favor of this system, as the steam pipes, being inclosed in a steel jacket, do not come into contact with woodwork or accumulation of rubbish, paper, etc.

It is claimed that the hot-blast system costs less in the items of first cost and running expenses than the ordinary methods of heating, as it requires a reduced area of heating surface, and is so constructed that in a majority of factories where large engines are used only a small amount of live steam is required, it being possible, except in the severest weather, to heat the building with exhaust steam from engine alone.

The accompanying diagrams were supplied by the Buffalo Forge Company, of Buffalo, N. Y., who furnished the apparatus shown. For further particulars and copy of catalogue illustrating the application of their apparatus to different factories and branches of industry address them as above.



THE PERFECTION OIL CAN.

The annexed engraving illustrates the "perfection oil can," an article that is of interest to every master mechanic and car-builder, who is trying to keep down to its lowest limit the cost of lubricants. The principle on which the "perfection oil can" is constructed is the simple one, well known in natural philosophy, and a part of the practical knowledge of every man, that where air cannot get in oil will not run out. In other words, when the inner end of the spout of the can is closed, the oil that remains in the spout will not run out. The construction is plainly shown in the accompanying sectional cut. Inside the body of the can is an opening leading to the nozzle, which opening is opened or closed by a flat valve which seats, air-tight, over the opening. This valve is loosely pivoted on the end of a lever, so that it is free to seat itself perfectly tight. The lever is fulcrumed about the middle of its length, and the valve is closed by the action of a spring made of the best quality brass spring wire, and which will not lose its elasticity in any position. At the opposite end of the lever from the valve is an upright pin extending through the top of the can and surmounted by a button. The operation is plainly to be seen. By pressing down on the button with the thumb of the hand holding the can, the valve is raised and the oil will flow out of the spout; as quick as the pressure is released the spring closes the valve and the flow of oil is instantaneously stopped. It is apparent that the quantity of oil that is permitted to escape may be gauged with the utmost nicety from a single drop up to any desired quantity, thus avoiding all waste, and insuring the greatest economy and cleanliness in the use of the oil. When the valve is closed, the can can be held with the spout downward, and not a drop of oil will escape unless the valve be opened by the pressure of the thumb. The can is sold by the Rau Patent Oil Can Company, Chicago.

The Frost Veneer Seating Company, 206 Canal street, New York, which is the largest concern in the world dealing in the kind of goods they handle, have added to their large establishment a railroad department, and have secured Mr. W. P. Seguine as manager, who until recently was with Peterson Bros., in the railroad supply business, and those who are fond of seats throughwhich the wind may blow will find him prepared to let them select from a great variety.

We have to acknowledge, with many thanks, a cordial invitation from Mr. C. W. Robinson, General Manager of the Detroit International Fair and Exposition, to visit the exhibition. It appears to be a very fine display, but we are reluctantly compelled to forego the pleasure of being present.

The New York Iron Car Company are having about three thousand new cars built. Their works at Huntingdon, Pa., that were burned down some time ago, are now running again, and they are turning out all the cars they can build. The Harrisburg Car Manufacturing Company, and several other car building companies, are building lots of the iron cars. About one thousand box cars, built according to the Iron Car Company's designs, are engaged on the Southern fruit trade, and they are highly spoken of for the small amount of repairs they require.

A VISIT, being a colloquial description of the Sherwin-Williams Co.'s paint and color manufactory, is one of the most handsomely gotten up illustrated pamphlets we have ever examined. The visit is used as an interesting method of illustrating and describing the works mentioned. A Mr. Brown and two friends from a distance, customers of the firm, call at the office and are invited to go through the works. Mr. Gray, one of the travelers for the company, who will be recognized by the personal portrait in front, meets the visitors and accompanies them through the large establishment. He tells them truthfully, as we can testify from making the round, that it takes two hours to go over the place. They first examine the palatial offices and reception room and then proceed to the storage and packing room, from whence they move around to all parts of the works, every step of their journeying being illustrated by striking pictures of the places, appliances, apparatus, machinery and plant to be seen. Meanwhile a very edifying conversation is going on between the visitors and the manager, to whom they are introduced, and it brings out an exceedingly interesting description of the great variety of operations going on in the manufactory. We commend all our readers interested in colors to obtain a copy of the *Visit* feeling sure that they will find its personal highly instructive while the cuts as works of art will afford pleasure to every person who has an eye to beauty of engravings.

Our Directory.

We note the following changes since our last issue. Our readers will do us a great favor by giving us prompt notice of any changes that may come to their knowledge of any error that may be noticed in our list.

Atlantic & Florida.—Mr. W. L. McGill has been appointed acting general superintendent, in place of Mr. T. O. Troy, resigned. Headquarters, Atlanta, Ga.

Baltimore & Ohio.—At a meeting of the directors in Baltimore, July 17, Mr. Alfred Walter was appointed general superintendent of the lines east of the Ohio River, with headquarters at Baltimore, Md.

Cairo, Vincennes & Chicago.—Mr. J. W. Simmons has been appointed superintendent, with headquarters at Mt. Carmel, Ill.

Carolina Central.—T. W. Whisnant, roadmaster of the western division, has been appointed superintendent, in place of Mr. L. C. Jones, deceased. Headquarters, Wilmington, N. C.

Chesapeake & Ohio.—William Hassman has been appointed master mechanic of the Huntington & Cincinnati Division of the Chesapeake & Ohio, vice F. A. Givin, appointed master mechanic of the Richmond & James River Division, vice William Hassman, transferred. The main shops are to be located on the Huntington & Cincinnati Division. H. R. Dill succeeds C. T. Dabney, resigned, as superintendent of the Richmond and James River Divisions of the Chesapeake & Ohio. M. B. Cutter, superintendent of the Peninsula Division and Richmond & Newport News terminals, succeeds Mr. Dill as superintendent of the Huntington Division, and S. D. Mayer succeeds Mr. Cutter.

Chicago & Atlantic.—J. H. Berry has been appointed master mechanic, vice W. H. Selby. His office will be at Huntington, Ind.

Chicago & Northwestern.—E. E. Hughes has been appointed assistant superintendent of the middle Iowa division, vice H. C. Manhanna, resigned.

Cleveland & Canton.—Samuel D. Mayer, superintendent, has resigned.

Cleveland & Pittsburgh.—L. F. Loree has been appointed superintendent, in place of John Thomas, promoted.

Duluth & Iron Range.—S. T. Pope has been appointed general superintendent, vice W. H. Brunson.

Houston, Central Arkansas & Northern.—Mr. James B. Greene, has been appointed superintendent, with headquarters at Monroe, La.

New York, Lake Erie & Western.—J. E. Sague has been appointed master mechanic at Hornellsville, in place of J. Bradt, resigned.

New York & Sea Beach.—John Van Ness has been appointed superintendent.

Norfolk & Western.—Mr. Nicholas D. Maher has been appointed superintendent of the branch roads of this company, with headquarters at Roanoke, Va.

Northern Pacific.—M. C. Kimberly, assistant superintendent of the Western division of the Northern Pacific, has been appointed general superintendent of the road.

Ohio Valley.—James P. Montgomery has resigned his position as superintendent.

Pittsburgh & Western.—W. M. Flahaven has been appointed master mechanic in place of J. H. Agnew, resigned.

Rio Grande Western.—W. H. Bancroft has been appointed general superintendent, with headquarters at Salt Lake City..

Rome, Watertown & Ogdensburgh.—W. S. Jones has been appointed assistant superintendent of the Western division, to succeed F. K. Britton, resigned.

Wabash.—Frank Morse has been appointed master mechanic, with headquarters in Fort Wayne, Ind., to succeed W. L. Morris.

Wheeling & Lake Erie.—W. R. Woodford has been appointed general superintendent.

Employment.

WANTED.—Situation wanted as Coppersmith in a railroad shop. Address H. C., Box 166, Huntington, W. Va.

WANTED.—A first-class Car and Locomotive Painter of 15 years' experience desires a situation. Address X, this office.

NATIONAL CAR AND LOCOMOTIVE BUILDER

OCTOBER, 1889.

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The Richmond & Danville have just let a contract for the building of three new mail cars.

The Indianapolis Car Works have received the contract to build 500 box cars for the Missouri, Kansas & Texas road.

Work will soon be begun on the machine shops of the West Virginia Central & Pittsburgh Railroad at Elkins, W. Va.

The Toledo, St. Louis & Kansas City is making plans for new shops covering 50,000 square feet of ground, to be located either at Marion or Frankfort, Ind.

The United States Rolling Stock Company have decided to put the newest and most improved style of machinery into the foundry of their shops at Anniston, Ala.

A statement has been made public that Mr. George W. Filton, of the Chicago & Northwestern Railway, has indorsed the Swinnerton locomotive. We doubt the truth of the story.

The Empire & Dublin Railroad has ordered two eight-wheel engines from the Rhode Island Locomotive Works. The East & West of Alabama has given the company a similar order.

The machine shops of the New Orleans & Northwestern Railroad, at Meridian, Miss., are to be enlarged by the erection of a two-story brick building, to contain machinery for car-building and paint shop.

Several accidents from the explosion of mineral oil lamps having occurred in railway cars in Buenos Ayres, the government has given directions that hereafter all railway cars are to have electric light fittings.

The West Virginia Central & Pittsburgh Railroad have decided to build machine shops at Elkins, and work will soon be commenced on the structures. Elkins will be made the mechanical headquarters of the company.

The machine shops of the New Jersey Central Railroad at Phillipsburg, which have been running on half time for several months, were started up on full time last month. They give employment to nearly a hundred men.

The Chicago, Burlington & Quincy Railroad Company have purchased 4,000 copies of "Baker's Manual of Instruction for Engineers and Firemen," for use among the trainmen on the system of roads controlled by this company.

The Newport News & Mississippi Valley Railroad Company have decided to increase the capacity of their shops at Huntington, W. Va. The buildings will be extended, and some good machine tools that are needed added to the present equipment.

The business of building street railway cars is receiving unusual attention among Western car builders. Hitherto cars of this kind have been almost all built east of Chicago, but now the St. Charles Car Company, of St. Charles, Mo., have established a department for street car construction, and the Missouri Car and Foundry Company, St. Louis, are also about to engage in the business.

Mr. W. H. Thomas, superintendent of motive power of the East Tennessee, Virginia & Georgia, has very sound views of the effect that a large exhaust opening has on the economical operating of locomotives, and his engines are ahead of anything in the country on large nozzles. He is running consolidation engines with a single nozzle 6 inches diameter, which gives 28.27 square inches of opening. He expects yet to open them up to 6½ inches.

The change of president of the Atchison, Topeka & Santa Fe is likely to have a depressing effect upon the Strong Locomotive Company. The new management of the Santa Fe are said to be trying to back out of the order given by Vice-President Smith for two Strong locomotives.

All but eight of the locomotives that were wrecked at Conemaugh and Johnstown during the flood have been received at the shops of the Pennsylvania Railroad Company, at Altoona, Pa. Seven have been repaired, and are now doing service on the road.

In a late sale of tools belonging to the Reading Coal & Iron Company there was a planer sold which was close on to 50 years old, and several lathes had been at work nearly as many years. It is no wonder that the company became bankrupt some time ago.

The Newburyport (Mass.) Car Company is building an experimental electric car. It is nearly double the length of the ordinary box car, and is to be run on six wheels. In running on curves the driver, by means of a patent attachment, can raise the forward and rear wheels clear from the track, so that the car will round the curve on the middle wheels

The practice introduced by the President of the Railway Master Mechanics' Association this year of appointing associate members on investigation committees promises to work very satisfactorily. Nearly all the chairmen of committees report that their associate members have displayed solicitude in giving all possible assistance in obtaining information for the committee.

The Mexican National are building large machine shops and car works at Laredo, Tex., which will be completed within two months. The buildings are very extensive, and they will be equipped with the best machinery in the market. When the works are finished all the mechanical production connected with the system will be concentrated at Laredo.

Pullman cars on the cable roads of Chicago is reported to be a contemplated improvement. Our experience with some of the Chicago cable roads makes us believe that there may be a project on foot to give the miserable passengers a chance to get a comfortable sleep during the journey of three or four miles, which sometimes occupied the greater part of a night.

The Great Eastern Railway, of Great Britain, has been experimenting with a mixture of tar and oils as fuel with a considerable amount of success. No structural change in the furnaces was necessary, and either coal or the liquid fuel can be used. The coal consumption of English railways is becoming a serious item and a movement to materially reduce it can be expected to commence shortly.

General Superintendent I. W. Sweigard, of the Philadelphia & Reading Railroad, was sentenced by Judge Finletter to imprisonment for six months and to pay a fine of $1,000 for maintaining a nuisance in the shape of a fence erected along the line of the Philadelphia & Reading Railroad at Port Richmond, cutting off access to streets on either side of the road.

H. K. Porter & Co., Pittsburgh, have sent us photographs of two small locomotives with cylinders 7 by 12 inches, which did the work in finishing the Cascade tunnel on the Northern Pacific Railroad. In our last issue we illustrated a small Porter locomotive that did the first work on the Northern Pacific. So the builders claim that their engines have done the first and the last work in the construction of that great railroad.

An Atlanta dispatch says: Charles Ellison, colored, who was indicted for murder on his own confession of having caused a wreck on the Georgia Midland road, near Warm Springs, last May, in which the engineer of the train was killed, has just been convicted of involuntary manslaughter by a Merriweather county jury. The maximum penalty for this offense is three years' imprisonment. Local branches of the Brotherhood of Locomotive Engineers have passed resolutions denouncing the verdict as a bid to train wreckers to continue their deadly work.

Cleveland, O., has several street railways that are successfully operated by electric motors, and this method of applying motive power to the cars appears to be popular with the people who use them. Electricity as motive power has several elements that would make it popular if it were only thoroughly reliable. It is cleaner than horses, and makes less dust and noise. It handles a car much more smoothly than cables, and is also less noisy. The citizens of Cleveland are so well pleased with electricity that those interested have been encouraged to try the experiment of running these cars at the rate of about eleven miles an hour through the city, and it is not thought that the City Council will object to this, since it is a well known fact that electric cars operated at this speed are much safer to the general public than horse cars run at only six miles an hour, since the electric cars can be stopped very much more quickly than cars propelled by animal power.

The Ohio & Mississippi road has received two handsome new vestibule cars, which it has placed in service between St. Louis and Cincinnati. They are finished in blue and gold and contain drawing rooms, two inclosed sections, toilet rooms, electric bells, etc.

Some experiments have lately been tried on the Philadelphia & Reading Railroad with electricity as a means of increasing the adhesion of locomotive driving wheels. Great increase of adhesion was claimed. We continue to be rather skeptical about the utility of electricity in this way.

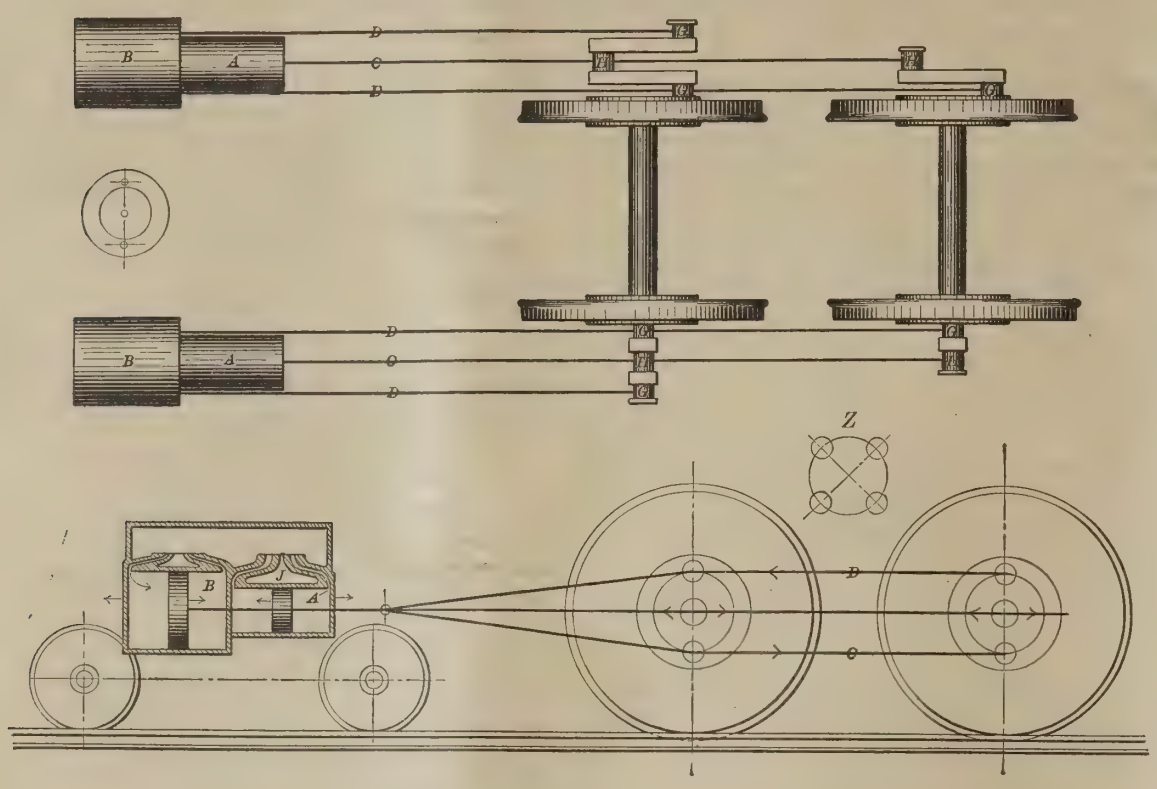
A Battle Creek, Mich., man has obtained a patent on an invention for reversing an engine, which is thus described: The combination of a cylinder of an engine, a valve chest having ports or passages connecting the central and end chambers thereof with the middle and the ends of the cylinder, respectively, and an annularly chambered piston, whereby live steam is admitted alternately in volume to the outer ends of the chambers of the valve chest to promptly move the valve to reverse the engine.

A successful dynamometer test of the Tripp anti-friction journal bearing was made Tuesday in the yard of the New York & New England Railroad, Boston, by J. B. Henney, Superintendent of Motive Power, and other officers of the road, and in the presence of representatives of the Thomson-Houston Company and many others. The test on cars numbered 150 and 156 of the Master Car Builders' standard journals showed a draughting strain of 600 and 800 pounds respectively, and on the 12-wheeled Pullman car "Clypso" a strain of 700 pounds. Car 158, with Tripp bearings, commenced running Jan. 28, 1889, and was guaranteed to run one year without any attention or additional lubrication, and has now run over 18,000 miles. This car was moved with a strain of 250 pounds, showing a saving of power of over 60 per cent. in favor of the Tripp bearings. The Tripp Manufacturing Company, 33 India Wharf, who are the sole manufacturers of these bearings, are about closing important contracts with roads in New England, Western and Southern States.—*Commercial Bulletin.*

The Commercial Travelers' Protective Association is an organization that has generally acted as if its members, the drummers had inherent right to all the earth. The latest move of this association is to put under passage in the Legislature of Georgia a bill which forbids a larger charge than $1 for a lower berth for a distance of 100 miles or less, and than 75 cents for an upper berth for a distance exceeding 100 miles. The charges for lower and upper berths shall not be more than $1, 50 or 75 cents respectively. The conductor of the car shall not be required to furnish an upper berth on demand unless all the lower berths are occupied, and it shall be unlawful to keep the upper berth lowered over an unoccupied lower berth unless the upper berth is unoccupied. The company operating the car is to furnish a fireproof safe, in which passengers may deposit their valuables; and passengers failing to avail themselves of it cannot hold the company responsible for any loss they may sustain. It has been alleged that this requirement of a safe has been introduced at the request of a manufacturer whose business would be increased by the demand thus created. It would be a very good thing in some ways. There is, however, the objection to a heavy safe in a car that it would be likely to act as a battering ram in case of a collision, and the number of people who would be accommodated by it would be very small.

The Wagner shops at East Buffalo, N. Y., have just turned out a new private car for Cornelius Vanderbilt. It is 76 feet long, and in external appearance resembles an ordinary Wagner car. The main saloon, observation room, two state rooms, kitchen and serving room are finished in mahogany, and two private sleeping rooms in quartered English oak. One of the latter is connected with a state room by a sliding-door, which has a full-length plate-glass mirror on each side. All the woodwork is highly polished and ornamented with superb hand-carving, some of which is in imitation of quilted satin. The interior decorations are of the Louis XVI. style, and the finish throughout is in harmony with the same. Instead of the ordinary berths the two private rooms have regular bedsteads, exquisitely hand-carved. Each compartment is fitted up with every toilet convenience, and large beveled mirrors of French plate glass are set in the wall. The car is wired for electricity, but for the present will be lighted with gas. The lavatories are supplied with hot and cold water, by gravity pressure. The head linings are of three-ply veneer with cloth facing, the centers being paneled in white, with carved gilt moldings, and the border outside decorated in gold tracery on a blue ground. The deck transoms are set with opalescent glass. The main saloon, in the center of the car, is 15 ft. long and 9 ft. wide. In the partition which divides one stateroom from this apartment is a great mirror of French plate glass, 4 × 6 ft., and it makes a brilliant decoration. At the opposite end of the room is a broad sofa, which can be converted into a bed at night, and above this is another massive mirror. The pattern of the Axminster carpet is bronze on a ground work of gaslight blue. The portieres are sage-colored raw silk. The upholstering is blue Tioga plush in the main room and in the staterooms, but in the private sleeping rooms it is velveteen of a delicate shade of blue. At the rear end is a large observation room.

THE WELLS COMPOUND LOCOMOTIVE.



The annexed engraving shows the general outlines of the cylinder connections of a compound locomotive patented by the Wells Engine Company, New York. No locomotive of this kind has yet been built, but the firm owning the patents expect to have one under construction at an early day, and they have a number of compound engines of the same cylinder arrangement at work in steamboats, and they are reputed to be highly efficient in the use of steam and in smoothness of rotation. As may be seen from the cut, the compounding is carried out by two cylinders arranged tandem, the high-pressure cylinder being nearest to the guides. The rod connections from the two cylinders are connected to pins opposite each other or at 180 degrees. When the high-pressure piston is on one center the low-pressure piston is on the other, and both pistons constantly move in opposite directions, so that the reciprocating parts connected with one crank pin counterbalance those connected with the other. By this means the bugbear of unbalanced reciprocating parts is overcome. The connections at the right hand side of the engine being set at right angles to those on the left, the four crank pins are equal distances apart round the complete circle, their relative positions being shown in *Z*. This entails some radical departures from ordinary locomotive practice. A double crank with three journals has to be used on the main drivers, and a half crank with two journals on the back drivers. The low-pressure cylinder has two piston rods and all the necessary attachments.

The method of using steam proposed to be followed with the locomotive, and practiced with the marine engines of the same type now in use, is to admit steam to the outside of the high-pressure cylinder through the passage *J* and regulate its admission by a slide valve above. The exhaust from this cylinder passes out at the ends of the slide valve into the steam chest, where it is ready for admission to the low-pressure cylinder, the steam chest being the only receiver employed. The intention is to operate both valves by one valve stem.

A practical railroad man is likely to perceive a good many grave objections to the mechanism that the patentee of this locomotive intends to employ, but few will dispute that the design is novel and interesting.

Value of the Brick Arch.

It is one of the curiosities of railroad mechanical practice that on many railroads the brick arch as an aid to clean and economical combustion is still an object of uncertainty. In places where there are laws against the nuisance of smoke that are enforced, the brick arch is forced into popularity, and where master mechanics devote strict attention to having the fuel used as economically as possible, the use of the brick arch is thoroughly appreciated; but where things are managed in a happy-go-lucky fashion, the brick arch is liable to be looked upon as an extra part that has to be taken care of with doubtful returns for the attention. The men who have most successfully used the brick arch marvel that intelligent men can be found who dare to question the economy of its use. As long ago as 1880, Mr. James M. Boon wrote to the chairman of a committee of the Railway Master Mechanics' Association about his experience with the brick arch, as follows:

"Have used the fire-brick arch with hollow stay-bolts. The first row of these bolts was 7 inches above top of grates, the next row 4 inches above these holes. The holes were three-eighths of an inch in diameter; there were sixty-two in all. With this arrangement we found that we could get about seven miles more to a ton of coal than could be made with the same engine without the arch and with the hollow stays plugged up. The combustion was almost perfect; if properly fired there would be no smoke from the stack. About the time we were using the brick arch we were having considerable trouble with fire-box sheets cracking, and we thought the arch might be in part the cause of the trouble, and abandoned it. Was at that time, and am now, very favorably impressed with the brick arch, and believe, with the fire-box steel (now being manufactured), the arch can be used to advantage. Have also used the Clark steam jet. This is an English invention, and was used there about 1857. It consists of holes in the fire-box, about the line of the top of the fire, about 12 or 15 inches from center to center (depends on length of fire-box), also holes in back end of fire-box; these holes to be from one and a half to two inches in diameter, each one to have projecting in from outside a small tube, say three-eighths of an inch diameter inside, the opening of this tube at end to be closed to about one-thirty-second of an inch; these tubes to be connected with steam pipes from boiler, regulated by a cock within reach of the engineer and fireman. The idea was to blow steam through these small tubes into the fire-box, carrying the air with it and forcing it into the gas, supplying the necessary air to produce combustion of the gases. By opening or closing the steam cock, the admission of air could be regulated—increased when fresh coal was placed on, or diminished as gases were burned. There is not much saving of coal by this arrangement with an engine, the boiler of which has to be forced to keep up steam. With a heavy train at slow speed the gases will all be consumed; with a heavy train at high speed they will be partly burned; at high speed with a light train all will be consumed. With large boilers of ample capacity very good results are obtained.

"The extent to which air can be admitted to a fire-box before it becomes detrimental to the steaming qualities of a boiler has not, that I am aware of, been definitely settled. Am of the opinion that, with boilers fed with bituminous coal there should be provision made for a free admission of air, so arranged that the quantity admitted can be regulated, or entirely shut off if necessary.

"I believe that the emission of smoke from bituminous coal, burned in the fire-box of a locomotive, can be prevented with any kind of a train or road. To prevent it, the first essential point is good firing. No matter what the appliances are, or how good they may be, bad firing will cause the emission of smoke from the stack. With an expert fireman good results can be obtained with a plain fire-box. Next to good firing, large boilers and fire-boxes are necessary. They should be so large that the full power of the engine would be developed without forcing the fire. As a general thing, our locomotive boilers are too small. The fire has to be forced from the start to keep up steam.

"I believe we will never get the proper results from burning coal in locomotive furnaces until the men on engines are educated to fire properly and with some idea of combustion. There is an insane notion with them that a coal-burner engine is not burning the fire right unless the black smoke is rolling from the stack; and instead of trying to prevent smoke, they are actually trying to make it. It will be found, I think, without exaggeration, that 95 engineers and firemen out of 100 will so express themselves, and they evidently believe it."

The First Sleeping Car.

From an article on Scraps of History, published in the *Railway Age*, we take the following particulars about the first sleeping car:

The first sleeping car was invented by Mr. Theodore T. Woodruff, who got up his model in the office of Mr. James Tillinghast, at Rome, N. Y., in 1854, the latter being at that time in the service of the Rome & Watertown Railroad. Mr. Woodruff endeavored to interest Mr. Tillinghast sufficiently in his invention to advance the cost of securing a patent from the government, but he did not have sufficient faith in its possibilities, and declined. It was while in a sort of dazed condition of mind resulting from being knocked off the top of a freight car by an old-fashioned inclosed bridge that Mr. Woodruff conceived the idea of a sleeping car. The model which he constructed in Mr. Tillinghast's office was carried to Springfield, Mass., in an old-fashioned bandanna handkerchief, and submitted to Mr. Wason, the car builder, who, notwithstanding an almost universal expression of disapproval by his employés, built a trial car, which made its first trips on the New York Central and Rome & Watertown railroads, and later was taken to Cleveland, Cincinnati, and other Western cities. This car afterward became the property of the Ohio & Mississippi Railroad Company, on whose line it was regularly run. Woodruff sold he right to build and use his sleeper on the New York Central Railroad to Mr. Webster Wagner, and on the Buffalo & Erie road to Mr. George Gates. The "Gates" sleepers ran from 1859 to 1873, when they also passed into Wagner's hands. Pullman sleepers were introduced in 1864 or 1865, he having made a number of important improvements on the productions of his predecessors. It was about 1862 that Wagner and Gates built their first car, having the same general features as those now used.

At the time Mr. Woodruff was at work on his first model he was employed on the Rome & Watertown railroad, first as conductor of a lumber train and later as foreman of car repairs. It was in 1857 that, having enlisted the assistance of the master mechanic of the Terre Haute & Alton railroad, whose foreman of car shops he had in the meantime become, that Mr. Woodruff was enabled to exhibit his model and arrange for the construction of his first car.

Primitive Brakes.

The Mohawk & Hudson connected the two towns of Albany and Schenectady, and was 17 miles in length, but that portion which was operated by steam was only 14 miles in length, horses being used on the inclined plane division from the top of one hill to the top of another. In those days the only brake used consisted of a wooden wedge, which was dropped in between the wheel and the end of the truck frame when the train was about to commence the descent of a grade. When it approached the station the station agent met it as it neared the platform, placed the wedge in position, and when the time arrived for it to start again on its trip, he removed it, and the train sped on its course. The first improvement on this brake consisted in placing a strip of leather on one side of this wedge. On one end of this wedge was a hole in which a broom handle or other handle was placed for convenience in operating the contrivance. As business increased and cars were added it was found impossible for the engineer to see all the cars of his train so as to determine if they were moving along in proper shape, so a guard was placed on top of the first car back of the engine, who kept his eye on the entire train and notified the engineer to stop when he discovered that any particular car bobbed about enough to indicate that it was off the track.

The next improvement adopted was the regular stage coach brake, operated by the foot. This was about 1841 or 1842. The first platform car was built about that time at Utica, N. Y. Its frame was latticed and the car was some 30 feet in length. The windows were three-cornered. Its frame was like that of the old fashioned highway bridges. The next car used on this road was built at Springfield, Mass.—*Railway Age.*

The drawing-room car was not invented until 1856, the first cars of this description being used on the New York Central road. The Old Colony Railroad had put on an old English compartment car with doors in its sides. A director of the New York Central road living at Newport, and having occasion to travel on the Old Colony road, became favorably impressed with this car, and at a meeting of the directors insisted upon its adoption, whereupon a committee, consisting of James Tillinghast, E. D. Worcester and Webster Wagner, were sent to examine the car above mentioned. This committee made a few trips on the car, carefully observing its various features, and decided that it was not adapted to long runs. On the way home the committee conceived the idea of a chair car as being better suited to the wants of the traveling public, reported its conclusion to the board of directors, and its suggestion was promptly adopted. To these gentlemen, and to this incident in the railway history of this country, are we indebted for the chair car of to-day.

Compound Locomotives.*

BY PROF. ARTHUR T. WOODS.

SECOND PAPER.

RATIO OF CYLINDERS.—In treatises on compound engines formulas are generally deduced for determining the ratio between the volumes of the two cylinders, so that the total work done by the engine will be equally divided between them. As usually given for receiver engines, these formulas are based either on the assumption that there is no drop in pressure in the receiver, or else it is assumed that the receiver pressure is constant. The rule most commonly given is that R equals the square root of the total number of expansions. In designing compound locomotives any such rule could be used only for a rough approximation at best, and in general would be of no value, since the requirements of construction place a maximum limit upon the size of the l. p. cylinder, which is less than that theoretically advisable.

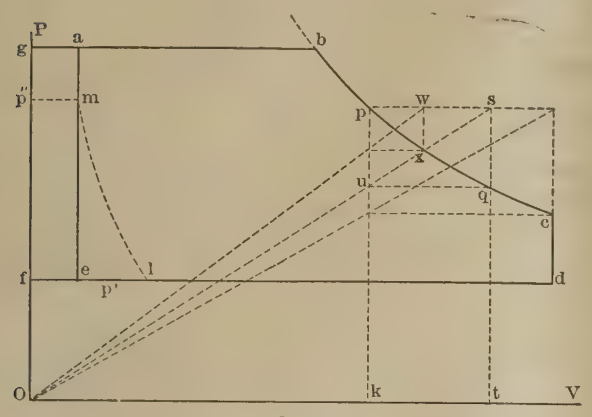


Fig. 5

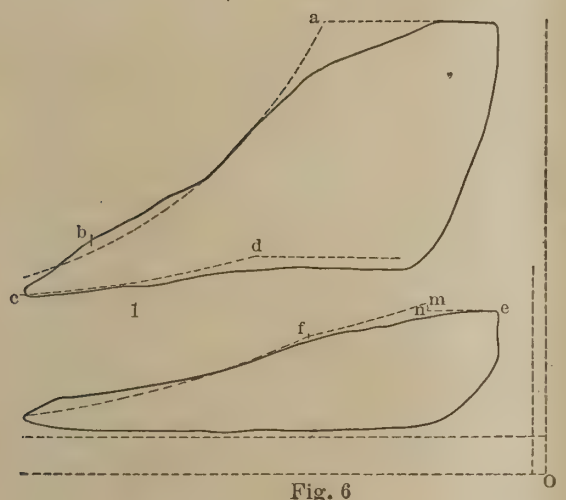


Fig. 6

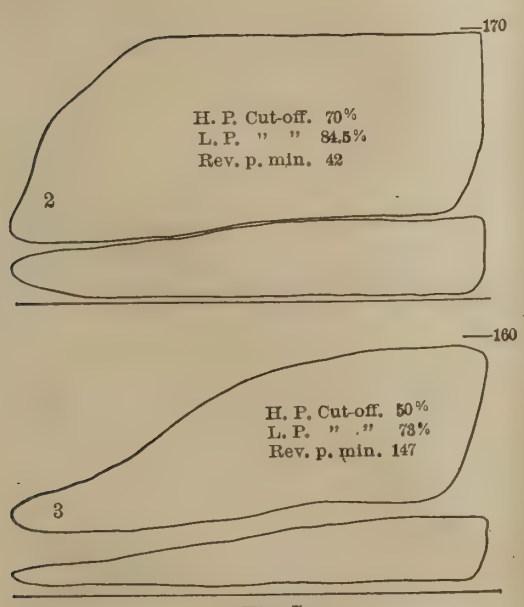


Fig. 7

The ratios which have been used for two-cylinder compound locomotives range from 2.74 for small engines to 1.77 for large engines. Mr. Mallet has stated that the ratio should not be less than two. Mr. von Borries, in his pamphlet on compound locomotives, recommends ratios of from 2 to 2.05 for large locomotives with tenders, and from 2.15 to 2.2 for tank locomotives.

These ratios have apparently been adopted by other designers, as we find that for the greater number of locomotives, of which records are published, the ratios lie between 2 and 2.1. With such ratios the division of the work between the cylinders is regulated by adjustments of the valve gear. Larger ratios than these are used for small two-cylinder locomotives, but it does not appear that ratios smaller than 1.9 have been used except in converted inside cylinder engines.

CLEARANCE.—In discussing the distribution and action of steam in a cylinder, the term clearance space, or simply clearance, is understood to mean the volume included between the piston when at the end of a stroke and the valve face at that end, and thus includes the steam port, the space between the piston and the cylinder-head, and any other spaces which are in communication with the foregoing, such as indicator pipes and cylinder drains. One of the principal effects of clearance is to make the effective cut off later than it would be without clearance, and this produces results which can be best illustrated by reference to a figure. Referring to Fig. 5, let $e\,d$ represent the stroke of a piston, and assume a cut-off at one-half stroke and 10 per cent. clearance. Then $a\,b$ is one-half of $e\,d$, and the apparent ratio of expansion is two. Lay off $e\,f$ equal to one-tenth of $e\,d$, then $f\,c$ or $a\,g$ represents the clearance. The volume which is filled with steam when cut-off takes place is $g\,b$, and this expands until it fills the volume of $f\,d$. The actual ratio of expansion is therefore $f\,d$ divided by $g\,b$, or in the present case $\frac{1\ +.1}{.5\ +.1} = \frac{1.1}{.6} = 1.83$ instead of 2. Expressing this as a formula, the actual ratio of expansion $= \frac{1\ +\ k}{n\ +\ k}$, in which k is the clearance expressed as a decimal of the volume displaced by the piston in one stroke, and n is the apparent cut-off, or one divided by the apparent ratio of expansion. The point c on the expansion curve is, of course, higher with a ratio of expansion of 1.83 than with a ratio of 2, and hence the mean pressure between b and c is higher. In making calculations the actual ratio of expansion should of course be used, but formula (1) will not then give correct results, as by it the mean pressure between g and c is found, and not that between a and c, and a correction must therefore be made which necessitates additional calculation. It is somewhat better to use formula (2), taking the corrected value for r, and still better in most cases to make use of a graphical construction. As an example of the application of formula (2), let the apparent cut-off be at one-third stroke with eight per cent. clearance. The actual ratio of expansion is then $\frac{1\ +\ .08}{.33\ +\ .08} = 2.63$, and the mean pressure between b and c will be $p_1\,\frac{.967}{1.63} = .594\,p_1$. This is for two-thirds of the stroke, and for the first third the mean pressure equals p_1. The mean for the stroke is therefore $\frac{2 \times .594\ p_1 + p_1}{3} = .73\,p_1$. The mean pressure calculated by formula (1) without correction would be $.70\,p_1$.

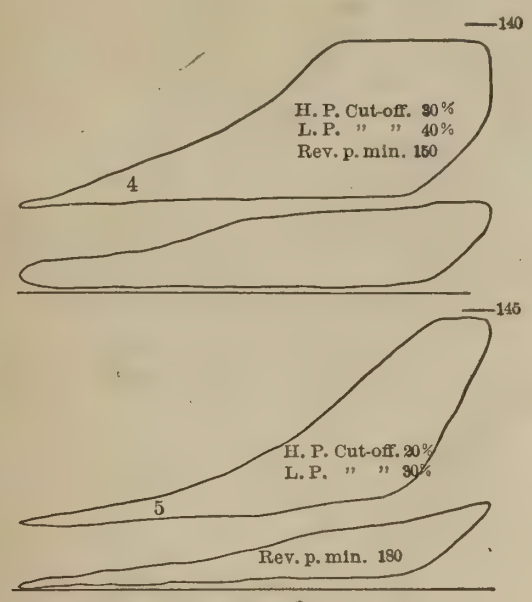


Fig. 8

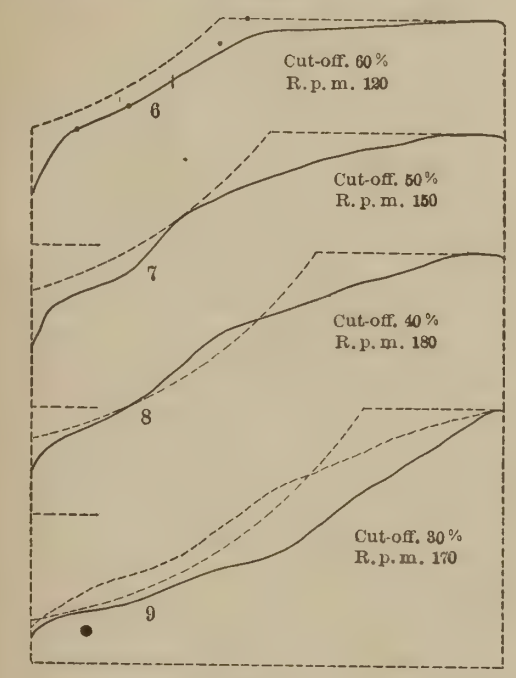


Fig. 9

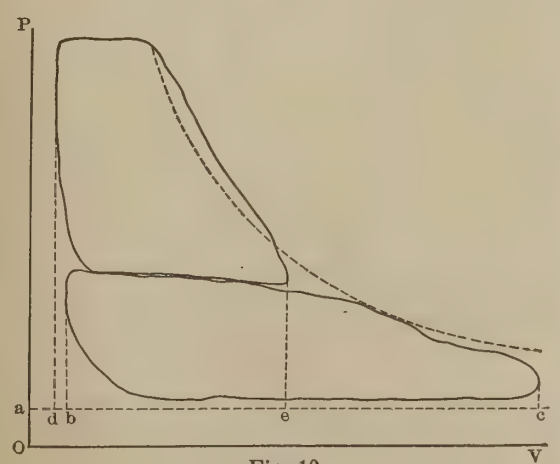


Fig. 10

CONSTRUCTION OF THE EXPANSION CURVE.—A simple method of plotting points on the expansion curve is the following, which requires only a triangle and a straight edge. In Fig. 5 let $O\ V$ be the zero line of pressures, $O\ P$ the zero line of volumes, and p a known point on the hyperbola. Through p draw $p\ s$ parallel to $O\ V$, making it of any convenient length. Draw $p\ k$ and $s\ t$ perpendicular to $O\ V$ and draw $O\ s$. Through the point u where $O\ s$ crosses $p\ k$, draw $u\ q$ parallel to $O\ V$, and where this line cuts $s\ t$ at q is a second point on the curve. Any number of other points can be found from p or q in a similar manner, as indicated in Fig. 5. An advantage of this method is that the distance of a point from $O\ V$ can be selected at pleasure, as it will be always directly under the point to which the diagonal is drawn, as q and s, or x and w.

COMPRESSION.—In considering compression or cushion in compound locomotives, we find that it is a factor of the steam distribution which it is more difficult to dispose of satisfactorily than in simple engines. For economy of steam, the pressure in the clearance space when the steam valve opens should be equal to the initial pressure, while the necessary pressure for cushioning the reciprocating parts is a problem in itself,

There is, of course, no advantage in compressing to a pressure higher than the initial pressure. In a simple engine having an initial pressure of 175 pounds absolute, and a back pressure of 18 pounds absolute, it is possible to compress to 9.7 times the back pressure before the initial pressure will be exceeded. If the same pressures are taken in a compound engine, for the h. p. initial pressure and the l. p. back pressure, we have the same possible range of compression, but it is divided between two cylinders. If the receiver pressure is 70 pounds absolute, the possible range of compression is for the h. p. cylinder from 70 to 175 pounds, and for the l. p. cylinder from 18 to 70 pounds, or 2.5 times in the former and about 3.9 times in the latter. It will be at once apparent that the valve adjustment for compression in the compound is a much more difficult problem than in the simple engine. For example, with 5 per cent. clearance, and the pressures as just stated, the pressure in the clearance space at the end of the stroke would equal the initial pressure in the h. p. cylinder when the exhaust closed at $2.5 \times .05 - .05 = .075$ of the stroke from the end, or at 92.5 per cent. of the stroke, as it is frequently stated. In the l. p. cylinder, an exhaust closure at 85.5 per cent. would fill the clearance space with steam at receiver pressure. With 10 per cent. clearance, and the same pressures as before, the earliest allowable points of exhaust closure would be 85 per cent. in the h. p. and 71 per cent. in the l. p. cylinder. It will be seen from this that a large percentage of clearance in a compound engine may be a positive advantage. The relations between the back pressure, the pressure from compression, the point of exhaust closure and the clearance, can be expressed in a general formula as follows: Referring to Fig. 5, let p' represent the back pressure and p'' the pressure in the clearance space at the end of the compression, both measured from the zero line of pressures; let l be the point of exhaust closure, $l\ m$ the compression curve which is considered as a rectangular hyperbola, $d\ e$ the stroke of the piston, and $f\ e$ equal k, the clearance as before. Then the fraction of the stroke at which the exhaust should close to produce a pressure p'' is

$$\frac{d\ l}{d\ e} = 1 - \left(\frac{p''}{p'} - 1\right)k. \quad (3.)$$

The problem of determining the amount of compression necessary to cushion the reciprocating parts does not differ essentially in compound and simple engines, and for that reason will not be discussed at length at this time. The work done in compressing the steam from l to e, Fig. 5, exceeds that done by the steam on the other side of the piston during the same time, and this excess of work tends to retard the piston. It will be evident that in determining the amount of this excess we can regard the back pressure line as the zero line of pressures, if it is parallel to the atmospheric line, and then determine how much the area $l\ m\ e$ exceeds the area of an equal length from the other end of the card. The actual pressure of the back pressure line,

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or whatever line is used for a zero line from which to measure pressures, is therefore of no importance in this connection, and hence the problem will be very similar in all steam cylinders.

Indicator Cards in Practice.—The indicator cards taken from compound locomotives in practice will, of course, differ greatly from those which have been called elementary theoretical cards, and which were illustrated by Figs. 1, 2 and 3. The cards taken from the engine should agree very closely with theoretical cards which are drawn according to a complete and correct theory. What has been called the elementary theory is not strictly correct, and is incomplete; but it is preferable for practical purposes to a more accurate construction on account of its simplicity, and because we cannot predict the exact form of an indicator card from an engine, which differs from existing types to an appreciable extent.

The causes which produce modifications of the elementary theoretical card, are chiefly the initial condensation and re-evaporation during expansion; the size, shape and location of the steam passages and the receiver; pre-release and compression; wire-drawing due to gradual opening and closing of ports, and the effects of high piston speed.

Indicator cards from a compound locomotive, in which steam was cut off at about four-tenths of the stroke in both cylinders, are shown in full lines in Fig. 6. The clearance space is 10 per cent. of the piston displacement in the h. p. cylinder, and 7.5 per cent. in the l. p. cylinder. The volume of the receiver is one and one-half times the h. p. cylinder. With this data the theoretical lines shown dotted in the figure have been constructed, making allowance for the excessive drop shown between the two cards. The differences between the actual admission and expansion lines of the h. p. card are the same as in cards from simple engines, and are due to the wire-drawing during admission and at cut-off, and to the re-evaporation during expansion. The extent of these departures from the assumed theoretical curve varies greatly in simple engines, and probably depends upon the piston speed, together with apparently small differences in valve gear and steam passages. The only satisfactory way of determining the probable loss in a proposed engine, whether simple or compound, is to examine indicator cards from an existing engine of the same general proportions, and having a valve gear of the same type and dimensions. This is also true of the loss of pressure between the boiler and the cylinder. Indicator cards taken from engines of various makes when on similar service show variations in these particulars of as much as 20 per cent., and it is obvious that no general rule can be laid down.

In Fig. 6, when the h. p. exhaust occurs at b, the l. p. piston is at n, and re-admission to the l. p. cylinder takes place, causing a rise in pressure to m. The l. p. piston moves from this position to that of cut-off f, four-tenths of the stroke, before the h. p. piston has moved over the remainder of its stroke from b to c. The pressure at c was calculated approximately on the basis of the receiver pressure when the h. p. exhaust opened, being that at f; but if the valve opened with sufficient rapidity this point would be found directly below b. From c to d there is compression as shown, and from d there is expansion until compression in the h. p. cylinder begins; but with the proportions above given, this expansion line is nearly parallel to the atmospheric line, or in other words, there is practically no expansion. Turning now to the l. p. card, and taking the pressure at e as that of the steam in the receiver, we find that the line from e to n is practically at constant pressure, and that the rise in pressure from n to m is comparatively slight. Also, that during the expansion from m to f the fall in pressure is not great. The drop between the h. p. and the l. p. cards in this figure has been referred to as excessive, and data which would furnish an explanation are not at hand, but this does not lessen the value of the cards for our present purpose.

In Figs. 7 and 8 are shown indicator cards from two-cylinder compound locomotives at different speeds and points of cut-off. The shape of the h. p. back-pressure line is to be noted. Cards Nos. 2 and 3 are from the same engine, and it will be noticed that the compression up to about the middle of the back stroke is quite marked, and that the remainder of the back-pressure line is nearly horizontal, as it was found in Fig. 6. In Nos. 4 and 5 the compression appears to continue during the whole of the back stroke. This is found to be the case in a considerable number of cards which have been examined, and is particularly noticeable at high speeds.

It will also be seen that the l. p. cards do not differ much in appearance from cards taken from simple engines. This would seem to indicate that we can without great error consider the receiver pressure as constant, and therefore treat the l. p. cards as if they were actually taken from simple engines. This arises largely from the effects of re-admission. It is not likely that, with the ordinary valve gear, the h. p. release will occur later than at 90 per cent. of the stroke, and an examination of a diagram of the crank positions such as Fig. 4, will show that the l. p. piston has moved over 20 per cent. of its stroke at this position.

The l. p. cut-off will not generally be earlier than three-tenths of the stroke, and hence it is safe to say that re-admission will always occur in practice. We have already seen that the practical effect of this is to make the l. p. admission line more nearly parallel with the atmospheric line, or, in other words, causes the l. p. admission line to more nearly resemble the admission line of a card from a simple engine.

In Fig. 9 are shown the admission and expansion lines of four indicator cards from the l. p. cylinder of a compound locomotive. The points of cut-off given are those which were recorded on the cards. The dotted lines indicate the form of the theoretical card for these points of cut-off and for the initial pressures as shown.

On card No. 6 a curve which agrees with the actual curve very closely is indicated by dots, and shows an earlier cut-off than that recorded. On card No. 9 the irregular dotted line shows the form of the card from the other end of the cylinder with the same nominal point of cut-off. It will be apparent from Fig. 9 that the l. p. cards do not differ more from the elementary theoretical cards for simple engines than do the actual cards taken from these engines.

To obtain a fair idea of the probable form of the cards from a compound locomotive but one factor now remains to be determined, and that is the probable pressure in the receiver. On this hinges the division of work between the cylinders, and there is, in fact, no general rule by which it can be calculated with any certainty. The size of steam passages, and the size and location of the receiver, all steam space between the valves of the two cylinders being included in this term, will control this pressure to a great extent, as upon these depends the losses of pressure due to friction in passages and to condensation. Mr. von Borries states, in his pamphlet on Compound Locomotives, that for cut-offs of from 30 to 40 per cent. the pressure in the receiver should be from 30 to 33 per cent. of that in the boiler. If the pressure maintained in the receiver of an engine in practice is known, the probable receiver pressure in a similar proposed engine can of course be predicted with some degree of certainty; but when any different arrangement of valves and passages is used, the distribution in previous engines can serve as a guide only. The following is suggested as a method of approximating to the probable receiver pressures. With the same initial pressure in the h. p. cylinder, as the h. p. cut-off is made later the receiver pressure will become higher, and a similar effect is produced by making the l. p. cut-off earlier. Hence a formula for calculating the receiver pressure should have the form $p = c \times p_1 \frac{\text{h. p. cut-off.}}{\text{l. p. cut-off.}}$ In this formula p is the absolute receiver pressure, p_1 the absolute h. p. initial pressure, and c is a numerical coefficient.

An examination of a considerable number of indicator cards from compound locomotives gave an average value for c of 0.46, but this value is not recommended except for approximations, and of course no such formula can take the place of direct experiment.

Combined Indicator Cards.—It is a common practice to combine the indicator cards taken from the several cylinders of compound engines in one diagram, and to compare this with an assumed curve of reference. The expansion of the steam in two or more cylinders can thus be compared approximately with an equal expansion in one cylinder, but it is not clear that much can be learned from such a diagram. The reference curve is ordinarily the rectangular hyperbola. Fig. 10 illustrates a combined diagram from a compound locomotive, of which the separate cards as taken closely resembled card No. 4 (Fig. 8). In Fig. 10 vertical distances represent pressures, and horizontal distances represent volumes as usual. Both cards must first be reduced to the same scale of pressures. Then take any convenient distance such as $b\,c$ to represent the volume of the l. p. cylinder, and let $a\ b$ represent the volume of its clearance space. Then $O\ a\ P$ is the zero line from which to measure volumes, and $O\ V$ drawn as usual is the zero line of pressures. Lay off $a\ d$ equal to the h. p. clearance space, and $d\ e$ equal to the volume of the h. p. cylinder, both on the same scale as that of the l. p. cylinder; or $d\ e$ should equal $b\ c$ divided by the ratio of the cylinders. The outlines of the cards are then found by plotting points as usual.

Prof. Elihu Thomson, of the Thomson-Houston Company, of Lynn, Mass., has evolved an electric welding machine on a movable car, by which the rails of a horse, electric or steam railroad line can be welded together as they lie on the bed, as rapidly as the car can be drawn or propelled over them. The rails are firmly welded together into lengths of 300 feet or more. It is said to have been demonstrated that in every 300 feet but one inch is needed for possible expansion of the rails by heat or wear, and this is provided for by a lap joint. Fish plates are done away with to a great extent, and the heavier single rail lies upon the road more firmly and solidly. The machine or car consists of an electric welding car of a new pattern, and an electric dynamo on the ordinary car truck. The car is propelled over the rails by its own power, or receiving power from the electric wires used on street cars. The welding of the rails is accomplished by the machine as it moves over them. The machine is now complete and ready to be placed in practical use, and inquiries for them have already begun to flow in to Prof. Thomson, and negotiations for their use from several railroad companies are already in progress.

On some European railways a reading lamp is provided, which passengers can use for half an hour on putting a small coin into a slot in the way that means for weighing, etc., are provided in this country. If some enterprising capitalist would supply the suburban trains of the Delaware, Lackawanna & Western with reading lamps of this kind he would find millions in it.

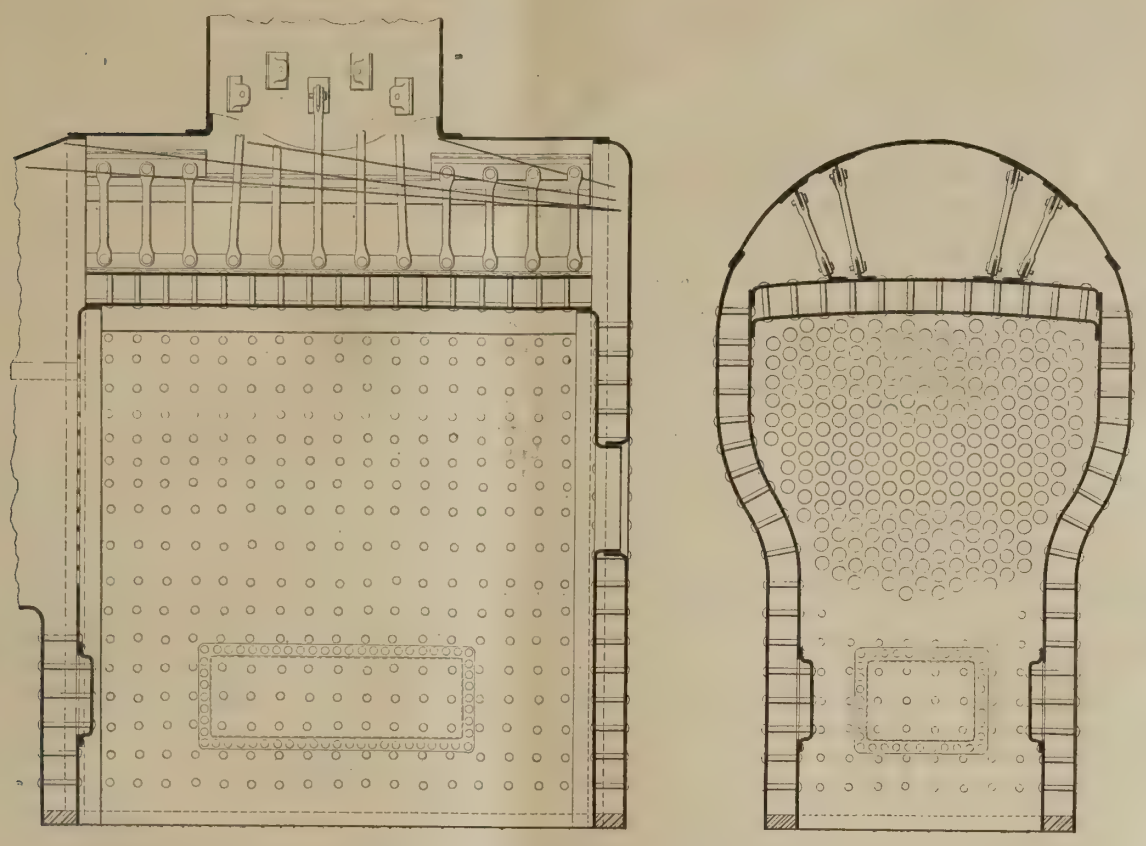
This is one of the few societies which gets together and really does something. There ain't a dead man in it. It is not a square root or hyperbolic society, but it is an association of hard-working, hard-headed men, who get together and hold an experience meeting.

The reports of their meetings are worth gold to the practical man, for they contain no theory whatever, but simple hard, solid experience of hundreds of men, while members of other societies seek only an opportunity to tell something. I never saw a man who had taken a degree asking for information from another man. He always wishes to impart. The railway master mechanic keeps mum and is always working for the man who knows.—*Chordal on Master Mechanics' Convention.*

In a recent issue we commented on the manufacture of Russia sheet-iron, and mentioned a process by which an American metallurgist expected to make that iron of a quality which would be as good as that imported from Russia. The *American Manufacturer* now arises in wrath and says: "There is nothing in the facts to in the least warrant the belief that locomotive builders prefer the foreign to the American iron, and that the latter is more liable to oxidation than the former. Indeed, just the opposite is true. It is safe to say that 99 out of every 100 locomotives in this country are covered with the American iron, and instead of the American iron being more liable to rust it is less liable. It is too late in the day to question either the quality or the adaptability for locomotives and other work of the American irons used in place of the Russian." As Horace Greeley used to say, "This is important, if true." We would, however, like to find a master mechanic with experience with both kinds of Russia iron who will testify to the superior merit of the home-made article.

A French engineer has prepared a paper giving the results of experiments on the transmission of heat through boiler plates, and the damage which may be caused to the plates through forced fires. The first series of experiments was undertaken to find out the efficiency of different parts of the heating surface in a boiler. These were carried out on an ordinary cylindrical boiler, with external surface. A section of the heating surface was isolated from the rest by internal partitions, and the steam produced on that section measured separately. It was found that immediately over the fire the average evaporation in ordinary work is about 30 pounds of water per square foot of heating surface per hour, and that with forced fires this may rise to 50 pounds, but at the risk of burning the plate, especially if it be covered with scale. In a second series of experiments the actual temperature of the plate was measured by means of fusible plugs of different melting points, and it was found that with clean plates, $\frac{7}{16}$ inch thick, the temperature of the plate never became dangerously high, even if the fire was forced. In another series the effect of incrustation and deposition of fatty substances on the inner surface of the plates was ascertained, and it was found very easy to produce the spheroidal state when the plates were covered with grease. Nearly all the fats were found to produce this effect, but linseed oil to a lesser degree than the other oils.

Reference has before been made to the fact that the railroad civil engineers prefer white pine to all other kinds for bridge building. A gentlemen in this city, who formany years has been a dealer in bridge timber, and therefore has an intimate knowledge of what is required on the different lines of road, explains that white pine is preferred for horizontal timbers, because it checks least of any available wood. Timber is wanted that does not check, for the reason that wood that season cracks badly permits rain water to run into the cracks, and that causes rot. Hence the engineers discard Norway oak and other woods for the horizontal sticks in bridges. For uprights it is not necessary to employ white pine. It is likely that the civil engineers have exaggerated the merits of white pine, as well as the demerits of other kinds of timber. Recently a large amount of yellow pine has been employed for bridge purposes in the North. It is to be noticed that the specifications for the approaches to the proposed Merchants' bridge, across the Mississippi at St. Louis, call for either white or yellow pine. The same was the case, we believe, at Memphis, when the proposals for the great railway bridge there were advertised. Large bills for timbers at Kansas City are qualified in the same way. It seems to be the custom in sections where white and yellow pine are equally accessible to specify either as admissible in contracts. This shows that the timber does not go on special merit peculiar to each, but is purchased with reference to its cost and readiness of supply.—*Northwestern Lumberman.*



BAIRD'S CROWN SHEET AND PATCH.

The annexed engraving illustrates a new style of crown sheet and an improved method of applying patches designed for locomotive fire-boxes by Mr. Archie M. Baird, boiler-shop foreman at the Wisconsin Central shops, Waukesha, Wis. The crown sheet has not been applied to a boiler, so its merit has not been demonstrated by the test of service, but the structural strength of the arrangement can readily be seen from the drawing. By the securing of two sheets with parallel surfaces together by means of stay-bolts an extremely strong crown is obtained, which could be kept clean more readily than where crown bars are employed, and additional fastening can easily be applied by means of sling stays. Without any additional stays this can be made a stronger crown than what is obtained with crown bars. Many master mechanics are anxious to dispense with crown bars on account of the sediment they accumulate where calcareous water is used, and yet are unwilling to trust to radial stay-bolts alone. We would recommend such men to look into the merits of the crown sheet arrangement of the invention under consideration.

The patch, as will be noticed, is dished so that the body of the patch projects past the seams. This way of applying a patch has been thoroughly tested by experience on locomotives using the worst kind of water, and gives much better results than the ordinary flat patch. It is well known that where scale-forming salts are present to any great extent in feed water, that after service of a year or two the sheets exposed to the most intense heat begin to crack, and when this element of destruction once sets in a patch is soon needed. After the patch is applied new trouble arises through the tendency of the seam to leak. Mr. Baird, who has had considerable experience with the fire-boxes on Iowa railroads, where feed water is nearly all tainted with lime, conceived the idea that the trouble with the patch seams arose from the pulls and thrusts transmitted to the seams by the contracting and expanding of the sheets, and he devised this patch of a form likely to be elastic enough to preserve the seams from destructive strains. When patches of this kind were put on, it was found that they lasted two or three times longer than flat patches. It is probable that the projection of the dished form of patch prevents the flame from impinging directly on the seam, and thereby preserves it from overheating. Be the cause what it may, the dished patch lasts much longer than a flat one, and therefore is worthy of attention from the men who are compelled to resort to patching as an unsatisfactory help, while doing their best to prolong the endurance of fire-boxes.

The Railroad Army of the United States.

In order to show how closely interwoven are the interests of railroad stockholders and the working classes of the country, a few calculations are herewith submitted:

If we estimate that in the operation of our railways there are employed in prosperous times an average of six persons per mile of road, it would show a total, on the basis of our present mileage, of more than 936,000 persons regularly employed in connection with that single interest; and if to this number we add 780,000—a number representing an average of five to the mile—as the number of persons employed in connection with all those industries which are directly affiliated with, and dependent on, our railway system, such as locomotive and car building establishments, rail mills, etc., etc., we have a total of nearly 1,716,000, or an average of 11 to the mile of railroad. Assuming that each of these would represent a family averaging five persons, we have an aggregate population of 8,580,000—nearly one-seventh of the total for the country at large—of which 90 per cent. are actually dependent on the railway system for the sustenance of life. If we allow, as the average rate of wages of those employed in operating, say $450 per annum, and for those employed in locomotive building, etc., say $500 per annum, we have a total pay-roll of $911,200,000 per annum, of which at least $500,000,000 is directly chargeable to operating account, while the remainder is for account of betterments, improvements and new construction. Add to this the amount paid to laborers engaged in construction in such a year as 1887. In that year there were built new roads whose aggregate length was 12,984 miles. If we take, as the average cost of labor in grading, track-laying, etc., for each mile of this total, say 10,000, and allow the average daily wages of laborers to be $1.50, with, say 100 laborers of all classes to each mile, this would show the average time for the completion of a mile of railroad to be 67 days. On this basis the construction of 12,984 miles of railroad would give steady employment for 300 days in the year to an army of 289,976 laborers, whose total earnings would be $129,840,000.

This gives a total of 2,006,000 persons, to which we will add 44,000 as the number whose labors are stimulated by the employment of the 289,976 last mentioned, making a total of 2,050,000, representing families numbering in the aggregate 12,250,000 persons. To maintain this number there would be expended by railroads and others under the above calculations at least $1,040,000,000 per annum, or very nearly $3,000,000 for each day in the year. The regular expenditure of more than 90 per cent. of this vast sum stimulates other industries, and in this manner the volume of general business is increased in progressive ratio.—*Poor's Manual.*

Mr. E. C. Baldwin, secretary of the Young Men's Institute, New York, writes us:

On Wednesday evening, Oct. 2, our class in the theory and practice of steam engineering holds its first session for the coming year.

The class will be taught by Mr. Wm. H. Weightman, M. E., and is intended for firemen, apprentices and engineers. The class will be held each Wednesday and Friday evening during the autumn, winter and spring until April 30. Those who desire to attend the class should apply to the Secretary of the Young Men's Institute, 222 and 224 Bowery, at once.

The latest idiocy in locomotives is a compound with two boilers, one on top of the other, and engine and tender are to be encased in a shell of thin iron tapering off to a point in front, the whole machine being 75 feet long and weighing in working order 91½ tons. It is to have two pairs of cylinders 15¾ by 19½ inches, and four coupled driving wheels 9 feet 9½ inches in diameter. Great power and great speed are both claimed for this novel combination of parts and proportions, the ordinary gait being modestly placed at 75 miles an hour, but this being capable of increase to 92 miles per hour. Thus far the scheme is exclusively confined to paper, but there is no saying how soon capitalists, who act as consulting engineers for themselves, may provide the means for making a practical demonstration that there are not millions in this kind of locomotive.

Americanizing Australian Railways.

Mr. Richard Speight, the chairman of the Victorian Railway Commissioners, recently returned to the Australian colonies after a six months' tour in America and Europe, and the result of an interview with him is published in a Melbourne paper, just to hand, giving the impressions made on him and the proposals he intends to make as the outcome of his observations abroad. Mr. Speight, by the way, was long connected with the Midland Railway Company here as assistant general manager prior to going to the colony. Although the visit was intended mainly as a holiday, we are told that a great deal of substantial and useful work has been accomplished, and that it will probably in the future bear fruit in connection with the development of the railway system of Victoria. Very naturally Mr. Speight was favorably impressed with the American style of railroad cars, and the distinct advantage it affords of communication from one end of the train to the other, and his idea is that upon the main trunk lines of the colonial railways the example of America in providing these through cars might be adopted. The system of "checking" baggage on to the station at which the passenger intends to leave the train, and of an "express" agent entering the car *en route* for instructions as to the delivery of the baggage at the destination of the passenger, for a small payment, was regarded as a great service and a decided reason for the adoption of the through car, by which alone the baggage conductor was enabled to receive the necessary instructions. But Mr. Speight would have this system under the direct control of the railway authorities, and not of an outside "express" company. The point, however, which had greater attention with him was the carriage of dead meat and other perishable goods, at present a problem demanding solution in Victoria. The system of carrying such goods in America is by icing the cars, and this railway experts declare a most suitable one. As Victoria cannot get natural ice, Mr. Speight investigated the various methods of producing ice artificially. Many establishments were visited, and Mr. Speight has obtained particulars as to the best means of making ice for railway and other public requirements. He has also obtained plans and specifications of what would be required by the department, from a railway point of view, and he intends to recommend the establishment of ice-making machines. Arrangements have also been made whereby samples of the best cars running in America may be sent out to the colony to thoroughly test them.—*Engineering.*

Within a few days arrangements have been completed between the Iron Car Company of New York, of which Mr. George W. Ettenger is manager, and the Minnesota Car Company, whereby the latter will build ore cars for the Iron Car Company for use in the West. The St. Paul *Globe* gives the following statement of this arrangement:

The two corporations have entered into agreement whereby the Minnesota Car Company assumes the construction of all iron cars for the West, Northwest and Southwest, and President J. F. T. Anderson and General Manager William E. Tanner of the Minnesota Car Company, and Mr. Ettenger left for the East with all details complete. To Duluth, the location of the manufacturing plant means the employment of several thousand skilled and unskilled workmen and the distribution monthly of tens of thousands of dollars; it means an addition to her population of thousands, and an advertisement throughout the breadth of the United States that cannot be estimated. Immediately it means the expenditure under terms of the contract, of $150,000 or $175,000 in dwelling houses alone for workmen. The consolidated company will spend $200,000 in new buildings and necessary machinery needed at once, swelling the total capital invested by the dual company to the magnificent sum of $750,000.

As to details of the industry, several erroneous statements have been given out by both local and outside papers. It was stated that the Iron Car Company asked a bonus of 200 lots at West Duluth, when, as a matter of fact, the company agreed as to terms with the Minnesota Car Company purely upon a private business basis, and without asking or receiving gratuitous consideration. The malleable iron works and the special mill for rolling the iron tubes, important adjuncts, but entirely independent establishments, asked and received 200 lots upon a bonded guarantee that from 50 to 200 houses should at once be erected at an average cost approximating $1,000.

Mr. O. W. Fine, a switchman on the Chicago & Northwestern, has invented and patented a red glass slide for placing on the ordinary locomotive headlight. He calls it a device for preventing collisions and other accidents. The idea appears to be that when two locomotives are approaching each other, the red slide will be dropped over the headlights, and the "lurid glare" will indicate that there is blood in the moon, and liability of its being found in a wreck unless the brakes do good work. One particular claim for the invention is that suburban trains, stopping at stations, can drop this red light during the stay at a platform, which would prevent the passage of other trains in the opposite direction until all the passengers had alighted.

Western Railway Club.

ELECTION OF OFFICERS.

The regular monthly meeting of the Western Railway Club was held Sept. 17 at the club rooms in the Phœnix Building, Vice-president J. N. Barr in the chair.

Mr. Smith, Chairman of the Committee on Press and Publications, made a verbal report, in which he recommended that the railway papers which received copies of the reports of the club's proceedings, should bear the expense of making such copies. On motion the report of the committee was received, and the recommendation referred to was adopted.

Mr. Sargent, of the Committee on Rooms, reported that the club could procure its present location for another year on the same terms as formerly, the good will of the master car builders and mechanics.

Mr. Cooke moved that a vote of thanks be tendered Mr. Carrington, agent for the building, for his kindness in giving the use of the room to the club, and that the secretary be instructed to send Mr. Carrington a copy of this resolution. Carried.

The treasurer then read his report, showing total receipts for the year, $707.18; total disbursements, $625.81; leaving a balance in the treasury of $81.37.

The secretary reported that at the opening of last season the club consisted of 119 members, which had increased to 180 at the present time.

Motion that the chairman appoint a nominating committee to nominate officers for the ensuing year. Seconded and carried.

The chairman appointed as such committee Messrs. William Forsythe, Verbryck and Cooke.

The committee nominated the following officers for the coming year: President, Mr. John Hickey; First Vice-President, Mr. J. N. Barr; Second Vice-President, Mr. C. A. Schroyer; Treasurer, Mr. Allen Cooke; Secretary, Mr. W. D. Crossman.

On motion the report of the nominating committee was received and adopted, and the secretary instructed to cast the ballot electing the gentlemen named.

The following resolution, proposed by Mr. Sargent, was carried unanimously:

Resolved, That in appreciation of the efficient and faithful manner in which Mr. Godfrey W. Rhodes has performed his duties as president of this club, we do hereby extend to him our heartfelt and sincere thanks.

A similar resolution extending the thanks of the club to Mr. W. B. Snow, past treasurer, was carried.

The secretary moved that the rooms committee and the press committee be continued for the coming year, to perform the same duties as heretofore. Seconded and carried.

Mr. Smith declined re-election on the press committee, but the chairman named the following: Messrs. Verbryck, Smith and Nourse. The Committee on Rooms was continued.

The secretary then read the following paper, written by Mr. W. H. Marshall, of the *Railway Review*:

EXHAUST PIPES, NOZZLES AND STEAM PASSAGES.

In assigning as a topic for discussion one which pertained to the passage of steam to and from the locomotive cylinder, it was most fitting that it should be made to include all of the three branches of the subject, namely, exhaust pipes, nozzles and the steam passages. Attention has frequently been directed to the pipes and nozzles, and many are the experiments which have been made with various forms of each. The passages have, on the other hand, been neglected more than they should have been, and yet, if we would consider the movement of the steam from the boiler to the cylinder, and from thence through the pipes and up the stack, these steam passages would naturally engage our attention first.

It will doubtless be agreed that to conduct steam from the boiler to the cylinder with the least possible loss of pressure and a minimum of condensation the passages should have ample area, should be straight, and should be well protected from losses due to radiation of heat from them. To make the passages perfectly straight is evidently impossible, but we should not lose sight of the fact that every abrupt bend is detrimental, and care should accordingly be taken that the path of the steam is not unnecessarily crooked. The area of the passage is not, generally speaking, limited by any features of the design of the locomotive, but may be made as great as necessary. This, however, has not been done in very many cases. It is by no means unusual to find 16, 17, 18 and even 19-inch cylinders supplied with the same sized throttle, dry pipe and branch pipes, regardless of whether they are switching, freight or fast passenger engines, and often these passages are none too large for a 16 or 17-inch engine.

When we investigate the size and shape of the live steam passages cored through the cylinder saddle from the base of the branch pipe to the steam chest, we often find a far worse state of affairs, for not only are these passages decidedly crooked, but they are also very much contracted in places. One of the most common ways of coring these passages is that in which the passage beginning with the same area as the end of the branch pipe is divided into two branches, one coming up into the steam chest at each end of the valve seat. Unless great care is taken, these branches will be too small. It is not sufficient that the combined areas of the two branches should equal that of the passage before division took place, for the balanced valves of to-day obstruct the movement of steam from one end of the steam chest to the other; and though this has been partly remedied by the passages usually provided through the steam-chest cover, it is, nevertheless, advisable to have each branch of the live-steam passage nearly equal in area to the main passage. And yet if some of these could be examined, their form and variation in area would be apt to suggest a badly kinked garden hose. Points in the passage would be found to be reduced 25 per cent. from the average, and indicator diagrams might show that we are unable to obtain boiler pressure in the cylinder and that steam does not follow the piston properly. May not some of the trouble be due to these ill-designed passages?

The necssity of all these precautions lies in the fact that the time for admission to the cylinders at high speed is so short. If the cylinder heads were removed and the throttle opened and steam blown through these same passages, the boiler would soon be empty, but while under such conditions it is found they are able to pass all the steam which the boiler could possibly generate, it does not follow that they are sufficiently large to guarantee an initial pressure in the cylinder equal to boiler pressure when running at high speed. The fact that the ports are open only part of the time entirely changes the conditions, and makes it imperative that the area should be ample, especially where entering the chest, as at these points the original single passage of the dry pipe has been divided into four, each of these four being the most direct path of the steam to some one of the four steam ports. The flow through the dry pipe will be practically continuous, but in each one of the passages entering the steam chests it is more intermittent in its character. To provide against loss of pressure by the friction of contracted passages they should be made much larger than is the usual practice to-day, and with more easy outlines and curves.

Another point worthy of attention is the exposed condition of some parts of the passages. It is very common practice to make part of the outside wall of the saddle one of the walls of the steam passage; in other words, have but ¾ inch of cast iron between steam at a temperature of 360 degrees and the outside air, whose temperature may be anything between 70 degrees above zero and 30 degrees below. Many master mechanics think the common steam chest casing not sufficient, and are now putting asbestos on both steam chest and cylinders. This is a move in the right direction, and should be supplemented by covering any exposed cylinder wall which has live steam on the other side of it. The under side of the cylinder saddle should always be boarded up to prevent a circulation of air around the passages.

The path of the steam to the cylinder has now been considered and considerable time given to it, because the writer feels that, generally speaking, railway men are more interested in the exhaust pipe and nozzles than in the live steam passages, and have let the latter go by default. The exhaust pipes and nozzles are, nevertheless, very important, and opinions vary very much as to the best form and size. Ample area and easy following curves are just as essential for exhaust passages as for live steam, and there is not much of which to complain in this respect in the best designs of the day. We therefore come directly to the exhaust pipes and nozzles. The office of these is to afford an exit for the steam with the least possible back pressure, and at the same time produce a sufficient vacuum in the smoke-box to give the necessary draught to the fire. It is evident that these two requirements are, in a certain sense, antagonistic to each other, for to make the steam create a vacuum on its way out is bound to cause more or less back pressure on the piston.

Did you ever calculate the horse power lost in one pound of back pressure when running at high speed? For an 18 × 24 inch engine, making 225 revolutions per minute corresponding to about 45 miles per hour with a 68-inch wheel), each pound back pressure throughout the stroke represents a loss of about 14 horse power in the two cylinders. And 5 pounds of coal per horse power per hour have been expended for it, and the railroad company is out 70 pounds of coal per hour for each pound of back pressure while the engine is running thus. It is therefore very important that the back pressure be as little as is necessary to make the draught.

As everything pertaining to the draught except the pipes and nozzles is outside the topic assigned we are limited to these two. In considering them one of the most important features is the position of the nozzle. To do its work to the best advantage the nozzle must be on the same center line as the stack, in other words, it must be a single nozzle. Allowing the steam to shoot up first one side of the stack and then the other cannot be the best possible arrangement, though it may do better than a poorly designed single nozzle. When the latter is used it will prove no better than double nozzles unless the shape of the passage through the pipes is such that the steam goes out of the nozzle in a direct line for the stack. An exhaust pipe in which the passages run parallel to each other until within about six or eight inches of the base of the nozzle, from which point they run quite abruptly into one, will be far worse than good double nozzles. Experiments, however, will produce an outline of a single nozzle which will give excellent results, and not cause any perceptible rise in back pressure in one cylinder from the exhaust of the other passing through the nozzle and "blowing over," as it is commonly termed; and when such a result is achieved the double nozzles will not be comparable with the single. In no case does the writer believe that the nozzle should have a lip on the inside of the opening. The contraction of area should be obtained by a true conical shape, with no obstructions in the path of the steam. What would be thought of a nozzle for throwing a stream of water to a great height which was the same internal diameter as the hose until, at a point a few inches from the end, it assumed an abrupt conical shape, and the exact size at the end obtained by an inside lip? And yet there are many exhaust nozzles of such shape in use on locomotives to-day, and the only valid excuse for using them is that the lip permits the use of one pattern for several sizes, as the lip can be bored out to suit, a practice which is far from economical.

The subject can be pretty fully summed up as follows: The steam passage should be as straight as possible, with no abrupt changes of direction, with ample areas, and fully protected from cold, while the exhaust should be just as carefully designed in regard to areas and easy following curves; and the pipes and nozzles should send a volume of steam of the largest possible diameter at the orifice consistent with a good draught, straight up the stack, with no variation either to one side or the other.

DISCUSSION ON MR. MARSHALL'S PAPER.

President Barr: Gentlemen—I think that this is one of the most important parts about a locomotive, and I hope we shall have a good discussion upon it. There has been a great deal written and a great deal said about other parts, and I think that this is one of the most important things to-day to which attention should be directed.

Mr. William Forsythe: I think it is more a matter of design than discussion. In the paper just read nothing is said of the length of the steam passages, except that they should be as straight as possible. I have always favored a single exhaust nozzle. It is rather difficult to discuss a subject on which there is very little disagreement, and I should like to hear some views the opposite to what Mr. Marshall has presented.

Mr. Cleaver (Vandalia line): I have nothing in particular to say upon this subject, Mr. President. We are using single exhaust nozzles.

Mr. Hackney: While on the Santa Fe road we used almost exclusively the single nozzle. I fully agree with the paper, that you should have ample area and as few sudden bends as possible in the steam pipes and passages.

The President: Are there no champions for the double nozzles here?

Mr. Cooke: I think Mr. Marshall has fixed it as well as it can be. I fully agree with him in all particulars.

Mr. Sargent (C., B. & Q.): I have some figures here, Mr. President, showing the evaporation of engines with different nozzles. With 3⅝ double nozzle and diamond stack, $5\frac{6}{10}$ pounds of water per pound of coal boiler pressure; $4\frac{3}{10}$ single nozzle, straight stack, extension front, $4\frac{2}{10}$; 4½ single nozzle, straight stack, diamond front, $4\frac{2}{10}$; 2⅝ × 3⅝ double nozzle, straight stack and extension front, 5. These figures seem to show that the double nozzle with diamond stack gives the best performance, but they are hardly comparative, as the conditions were somewhat different. I think the fireman has a great influence on the evaporation. A poor fireman will always want a small nozzle.

Mr. Riley (Michigan Central): I think, Mr. President, the dry pipe is the most important of all. You will see a 16, 17 or 18 cylinder with a 6-inch dry pipe, and I don't think it is possible to get good results with a dry pipe of that size.

President Barr: I have looked considerably into this subject myself, and I must say that while the literature on the subject seems to incline to a single nozzle, I have not so far been able to get as good results out of the single nozzle as out of the double, and I hardly know how to account for it. There is one thing certain about a single nozzle, it is not as easily adjusted as a double nozzle. The steam passes intermittently through the single nozzle, and if you make it a little larger you should at the same time alter the size of the pipes. In the single nozzle the steam opening is down where the two pipes come together, and the single nozzle may be 4 inches or 5 inches in length and make very little difference on the velocity of the steam as it passes the tip, because that is to a very great extent dependent on the size of the double part of the exhaust pipe. If that is as small as the tip of the single nozzle, and it very often is, then it does not make very much difference whether or not you enlarge that tip to twice its size. I am inclined to think that with our tests the action of the single nozzle was of too much an intermittent character. The steam passes out more in sudden puffs rather than being drawn off, and it makes a very severe pull and varies the vacuum, while with the double nozzles you can regulate the vacuum, and it is more uniform. I presume some of you have had difficulties of that kind also, and if any of you have single nozzles that are working more satisfactorily than double nozzles under said circumstances, I think it would be a good thing to let the club know.

Mr. Cleaver: We noticed one thing in particular in changing from the double to the single nozzle, and that was the difference in the exhaust. It was very noticeable. The exhaust was much softer, and apparently more continuous. I think we noticed that on every engine where the change had been made, and while it is pretty hard to tell about the amount of sparks that were carried in the front end, it seemed as if there were not so many. So far as the consumption of coal was concerned, there seemed to be no difference, and we made no tests to get at that part of it. I notice that Mr. Marshall's paper says that the shape of the exhaust nozzle should be a cone, a true cone, I believe it says, and also calls attention to the fact that most roads like to use the same pattern. Now, it has occurred to me, would it make any difference if we made this cone for our smallest engines, and then bored through into that cone in a parallel line? Would that cause the trouble that he lays to the lip? The steam would approach it in the shape of a cone, and then would escape in a parallel line with the stack. If I understand it, the intention is to have the steam, after it leaves the nozzle, spread as quickly as possible and fill the stack. Would it not be more liable to fill the stack in that manner than in the shape of a cone?

The President: The question proposed is: Will the steam after it leaves the tip of the nozzle spread more if the shape of the nozzle inside is conical than it will spread if the inside is cylindrical for a certain distance?

Mr. Hughes: I have always found the best results from single nozzles. I would hardly like to give an opinion on the question proposed.

Discussion on this subject closed.

STANDARD AXLE BOX FOR 40,000 AND 60,000-LB. CARS, AND BEST BOX LID.

The President: Will you open the discussion on this subject, Mr. Verbryck?

Mr. Verbryck: I have not given that much thought yet, but I am inclined to think that we could get up a great deal better box than the present Master Car Builders' box, which I think is about the homeliest looking thing that could be invented. I had a box before the M. C. B. standard came out, and I have never ordered the standard, but I do not consider it the best box that could be made. I do not know that I could say much about the best form at present, but as to the lid, I consider the Fletcher as about the best, and if we make a standard box, I should be in favor of adopting the Fletcher lid as the standard.

The President: Is there anything to be said about the capacity of box for 60,000-pound cars?

Mr. Pullman: We have nothing over 40,000 pounds capacity on our road, and I don't know whether we ever shall have or not. That is one reason why I have never thought the matter up.

Mr. Potter: I have not given the subject a great deal of thought. What we use for 60,000-pound trucks is somewhat after the design of the M. C. B. standard. The first consideration is, whether the collarless axle or the axle with the collar is the better form. Then comes in the consideration of the box, One of the greatest troubles we have is from the end wear of brasses. As to the design of box, I should hardly feel able to express an opinion. I agree with Mr. Verbryck regarding the design of lid.

Mr. Verbryck: We have been voting on a standard axle, an axle with a collar. I believe the 25th of this month is the date of the closing of the vote.

Discussion on this subject closed.

WORLD'S FAIR.

The following resolution was offered by Mr. George M. Sargent:

Whereas: An organization has been effected in this city the object of which is to secure to Chicago the World's Exposition in 1892; and

WHEREAS, the importance of the movement is being recognized by the various railroads centering here, as well as by all classes of business, therefore,

Resolved: That we, the members of the Western Railway Club, believing as we do that the World's Exposition if held in Chicago in '92 will prove of inestimable value to our whole country and especially to Chicago and the Northwest, pledge ourselves to do all that lies in our power toward securing to this city the World's Exposition in 1892.

Seconded and carried.

Adjourned.

Master Car and Locomotive Painters' Convention.

The twentieth annual convention of the Master Car and Locomotive Painters' Association was held in Chicago, beginning Sept. 11. President Brown, of the Old Colony, presided. In the opening address the president dwelt on the aims and objects of the association. He urged the members to exert themselves more zealously on behalf of the organization.

Secretary McKeon read his annual report, which showed that the association was prosperous financially and in the increase of membership.

The secretary's report was adopted and was followed by a short verbal report by President Brown upon the encouraging prospects of the association. The election of officers for the ensuing year resulted in the choice of A. E. Barker (C. & N. W.), for president; Wm. Lewis (Grand Trunk), first vice-president, and E. L. Fetting (N. Y. & N. E.), second vice-president. Secretary McKeon was again re-elected secretary and treasurer.

During the meeting reports were read on how to paint the heated parts of locomotives; inside coach finish; what constitutes the best filling for engine driving wheels and other rough castings, quick work being considered; rubbing and finishing varnishes; how long should a properly painted locomotive run before being cleaned and revarnished? What grade of varnish gives the best results, a hard drying or a lasting finishing?

Does a neatly striped and decorated passenger locomotive and train attract the attention of the traveling public more than those painted very plain, and will the cleaning on the latter be done as effectually as on the former?

Discussions followed the reading of the reports.

E. L. Fetting, of the New York & New England then read an essay upon the following subject:

The benefit that railway companies may derive, and a plea to superintendents of rolling stock and master mechanics to recognize and encourage the Master Car and Locomotive Painters' Association, by furnishing their foremen painters with passes and allowing them to attend the annual meetings.

Mr. Fetting's essay was accepted and placed on file.

Reports were read by Wm. Lewis (Grand Trunk) and by the secretary for H. W. Walton (P. & W.).

After a brief discussion upon this matter the reports were accepted and the next subject in order taken up, as follows:

The Master Car Painters' formula for painting the outside of a passenger car, giving detail for priming to the last coat of varnish. Method with and without rough stuff.

The committee on this subject were not prepared to report, and desired an extension of time. Their action drew out a brief argument upon the merits of different formulæ.

The president appointed the following committees for the ensuing year:

Advisory Committee—E. L. Fetting, N. Y. & N. E.; Samuel Brown, O C.; George H. Gillingham, C. & N. W.; John Ratterbury, C., R. I. & P.; M. W. Stines, Barney & Smith Manufacturing Company; W. F. Hogan, A., T. & Santa Fe.

Committee on Information—Robert McKeon, N. P. & O.; H. W. Walton, P. & W.; F. W. Wright, M. C.; A. P. Sweet, D., L. & N.; J. G. Keil, C., A. & St. L.

Committee on Tests—William Litner, B., C. R. & N.; A. T. Schroeder, C. M. & St. P.; A. S. Coleman, Intercolonial; George Paullis, L. E. & W.; W. McNabb, B. & O.

Boston was decided upon as the next place of meeting, and, after passing a vote of thanks to the officers of the association, the supply men, the hotel people, and the members of the press for courtesies received, the convention adjourned.

We will publish most of the reports as space permits.

Rubbing and Finishing Varnishes.

At the last Master Car and Locomotive Painters' Convention, Mr. Robert McKeon, New York, Pennsylvania & Ohio, read the following paper:

Permit me to give a few plain statements on this question, covering what I have learned from a practical experience in the paint shop. I believe that the greatest and best results are usually reached by following the most simple and practical methods. Some aim too high, they look for something beyond, while the knowledge we are seeking may be acquired by looking into the small things which come up in our every-day experience in the shop. It is the seeming trifles that afford every car painter the opportunity of laying up a store of useful knowledge, and what I may advance on the subject before us to-day will reflect only on my limited experience and judgment.

I do not presume to speak for any other car painter or for any member of this association, but to give you the results I have obtained in the use of the two grades of varnish in question. I shall not diverge from the subject farther than may be necessary to fully explain the difference in the wearing qualities of rubbing and finishing varnish.

It is a very important question with me whether to take a decided stand on either side of the subject, for the reason that the different methods adopted in painting a car body have much to do with the varnish, and if the car is coated with a pretty flat color from the priming up to the varnish, then I should recommend a coat of rubbing varnish applied over the dead color. This gives you a foundation for the succeeding coats of wearing body varnish, as its quick drying prevents it being absorbed by the raw color to the extent that the finishing varnish would be, and the oil in the varnish, which is the life of it, in place of being in the gum for the protection of the surface, is sucked up by the dead color. Now if the car is brought up to the varnish with an elastic color—that is, a larger portion of oil in it—it is plain that there is not that power of absorption in it that there is in the flat or dead color.

The question might be asked here, which is the best of the two colors, elastic or flat, to hold the varnish? My plan is to use an elastic color, consequently I use no rubbing varnish over it. If I should do so, I would expect to see a cracked surface on my work in a few months' time. Therefore, in giving my experiments and the results obtained with the two grades of varnish, remember that I have always had an elastic color to apply it on. By the term elastic I do not mean to say that I have any gloss on the color, but I prepare it so that it will dry down to a soft velvet-like appearance, and I can gild on any of my body colors without the aid of the pounce bag to prevent the gold from sticking.

About twelve years ago I entered into a series of tests with rubbing and finishing varnish. Previous to this time I had used rubbing for the under coats, giving but one coat of finishing, but, having some trouble with the varnish cracking, I started out to find the cause, and, if possible, apply a remedy. My first move was to abandon varnish color entirely on the body of a car, which I had been taught to use from the earliest days of my apprenticeship in the car shop. In place of the third or last coat of color being mixed with rubbing varnish I gave the car the required number of coats of flat color and applied a coat of rubbing varnish; this I rubbed, then decorated and striped and applied a second coat of rubbing, rubbed again and gave one coat of finishing.

In my experiments at this time I turned out several cars with two coats of finishing varnish over flat color, the decorating and striping being done before any varnish was applied; these were put in service at the same time with the cars that had the two coats of rubbing and one of finishing. I examined them frequently and found that the car with two coats of finishing varnish stood equally as well as those with the two coats of rubbing and one of finishing, and another thing I observed was that there was no cracking on the cars turned out with finishing varnish only, an evil I had to contend with on cars with the two grades of varnish on them. I made myself fully satisfied of this fact, that two coats of finishing varnish was equal to two coats of rubbing and one of finishing. I have, therefore, finished all my work for the past twelve years with but two coats of varnish, and am well pleased with the results.

Rubbing varnish, as I have generally found it, is of a brittle nature and has but little wearing qualities in it. It is intended merely for filling up, or producing a surface, while the wearing body varnish is intended for service and durability.

Some may ask if three coats of finishing varnish would not be better than two coats. I answer, No; unless you expect the car to remain in service over twelve months before coming in the shops to be cleaned and revarnished. I have had cars finished with two coats come in at the expiration of one year and clean up and varnish nicely, giving, as before, two coats of finishing, and the second year it will do still better service than the first, as the paint has a more solid and less porous body to resist the dirt and hot cinders, as well as the sudden changes of weather which it is continually subjected to.

Now the second part of the subject, which relates to the quick method of varnishing, deserves our consideration. I do not believe that any practical car painter ever introduced the so-called repeating process in varnishing. He may have been forced to do it, as many of us have to do many things that we know is positively injurious and detrimental to the wear and durability of the painting.

About eight years ago the repeating process in varnishing was considerably agitated and some of us gave it a trial. I finished several cars, putting on the varnish 24 hours between coats, but I have never yet found out where the advantage was. It certainly could not be found in the increased durability; it did not dry with any better luster, nor did it flow out as smoothly, but it dried rather with a dim and sunken appearance. It was not any drier when put in service than the car that had four days between coats, which is the time I give my first coat of varnish to dry. At the same time I gave two cars three coats 24 hours apart and turned them at the same time as those I gave but two coats. At the end of twelve months the cars came in and were cleaned up and re-varnished, but nothing could be said in favor of the three-coat job, varnished in three days, over the second-coat job, which was varnished in five days. As for getting the car into service any quicker by this rapid method of varnishing I fail to see how it can be done. Another very important matter was that the cars done by the repeating process did not clean up as well as those that had the proper time given them for the varnish to harden between coats; the dirt seemed to be imbedded deeper in the varnish.

We all know color will work by putting on the second coat before the first is fairly dry. What kind of a job do we often see on hurried painting where two or three coats are applied in one day? It dries spotted, sinks in, and leaves an enameled surface. Two coats of varnish on a car body, well dried before being exposed to the weather, is better than three coats put on hurriedly and turned out for service before being dried. We have all observed the drying of varnish, and know that it takes double the time for two coats of varnish to dry together that it would require for either coat alone.

The luster is destroyed by this repeating method, the first coat of varnish not being dried. The next coat prevents it drying properly, as this will skin over on the surface in from 12 to 20 hours, according to the make of the varnish; this second coat therefore shuts off the oxygen from coming in contact with the first coat, and such a mass of varnish drying together is the principal cause of what we term flattening. The brilliancy of varnish is preserved only when the surface on which we apply it is perfectly dry and hard. Now if the luster of the varnish is gone the durability is greatly impaired. The resistance to the atmosphere lies mainly in the solid and smooth varnish that covers the body of the car. I certainly cannot indorse the quick method of applying varnish. Careful and repeated tests in the matter have fully convinced me that there is neither economy nor increased durability in it.

Handy Tools for the Paint Shop.

Generally speaking, the paint shop, compared to the other departments of the average carriage shop, is sadly in need of more and better tools to expedite work. The painful lack of such tools does, to a certain extent, materially affect the question we hear so frequently propounded, "Why don't the paint shop pay?"

In the matter of scraping varnish, burning off paint, etc., the tools ordinarily used in some shops are entirely unsuited to the work. In shops where modern appointments are boasted of, even, one finds the use of an old chisel, plane bit or mowing machine knife still in vogue. Most every painter whose experience dates back a decade or more knows what scratches and gouges can be produced without apparent effort with such instruments.

In the early days of my apprenticeship I ran across an item relating to needful tools in the paint shop that interested me, and in a brief time I was the possessor of a few handy tools that were far and away head of plane bits and machine knives.

For scraping varnish take an old saw blade that has been thrown aside, and from the largest part cut a triangular shaped piece. In this cut a square hole in the center, inserting a bar with a thread cut on the end. Put on a washer of leather next to the blade. This bar or handle should be what in shop terms is called goose-necked. This will enable the workman to keep his hand clear of the panel when scraping, and, moreover, to bear more equally on the cutting part. This tool can be made with a wooden handle on the end of the bar. At the option of the owner it can be taken apart and stowed into small quarters. A similar tool, with one side half round for concaved parts, made with bar handle as in first tool, will be found desirable. A smaller tool, having one end concaved for moldings, fitted with handle, will complete a very convenient and useful set of tools for scraping varnish. Such tools can be held steadier with less labor than the old kind. Then, too, there is small danger of gouging or disfiguring the work. I have found the best manner of sharpening them is to put on a bevel edge with straight edge toward me, and then draw the tool the same way.

In burning off bodies I use the same tools, using, however, in addition, a steel blade made from an old file hammered out to a width of 2¼ inches. I so arrange the flattening process that the handle end of the file can be retained; then, with a couple of smaller tools made from old files or like material, to use in and about convexed panels, moldings and other difficult places, the kit for body work may reasonably be considered quite complete.

For scraping old paint from gears some of the tools above mentioned may, of course, be used to advantage. An instrument made with a piece of steel tire, for instance, with handles on both ends, works nicely in dressing down the flanges or spokes. Another tool I have found needful is made from a half-inch file flattened out, with a handle arranged on one end. This tool is six inches in length and near the handle is concaved sufficiently to fit a 1¼-inch spoke; then, at the proper distance, concaved again for an inch spoke, and finally for a three-quarter or seven-eighth, as is required. I deem this an almost indispensible tool. For getting in and around spokes, axle clips, felloe plates, etc., a steel scraper blade, at least eight inches long by three-quarter wide, thin as the blade of an ordinary table knife, with one end crooked to the extent of seven-eighths of an inch, has proven itself of much value From a piece of thin spring steel a blacksmith can make one in a few minutes. A small chisel-shaped tool for rims, fronts of spokes and places of like character will complete a very necessary paint shop outfit for varnish and paint-scraping purposes. Every painter can have, with but an infinitesimal outlay, the few tools practically adapted to his needs outlined in the foregoing suggestions. Properly cared for, as they should be, they will last a lifetime. Kept in a small box made for the purpose, they will require but little attention, and when wanted can be easily found.—*Painters' Magazine.*

How 33,000 Pounds was Made a Horse Power.

When men begin first to become familiar with the methods of measuring mechanical power, they often speculate on where the breed of horses is to be found which can keep at work raising 33,000 pounds one foot per minute, or the equivalent, which is familar to men accustomed to pile driving by horse power, of raising 330 pounds 100 feet per minute. Since 33,000 pounds raised one foot per minute is called one horse power, it is natural for people to suppose that the engineers who established that unit of measurement based it on the actual work performed by horses. But that was not the case. The horse power unit was established by James Watt about a century ago, and the figures were settled in a curious way. Watt, in his usual careful manner, proceeded to find out the average work which the horses of his district could perform, and he found that the raising of 22,000 pounds one foot per minute was about an actual horse power. At this time he was employed in the manufacture of engines, and had almost a monopoly of the engine building trade. Customers were so hard to find that all kinds of artificial encouragements were considered necessary to induce power users to buy steam engines. As a method of encouraging business, Watt offered to sell engines reckoning 33,000 foot-pounds to a horse power, or one-third more than the actual. And thus, what was intended as a temporary expedient to promote business, has been the means of giving a false unit of a very important measurement to the world.

The managers of the railroad men's reading rooms connected with the Grand Central Station, New York, have arranged to hold lessons in mechanical drawing during the coming winter. Mr. P. F. Lonergan, chief draughtsman of the New York Central, will be the principal instructor, and Edwin Larkin will be assistant.

Railway Car Construction.

BY WILLIAM VOSS.

Thirteenth Paper.

FREIGHT CAR BRAKES.

The medium employed to check the speed of moving trains or bring them to a stop is friction, applied at the periphery of the car wheels. There are some instances where track brakes are used in addition to those on the wheels, but as this is the case on some special mountain or cable roads only, and not on regular steam roads, they will not be considered here.

The apparatus required consists of rubbing blocks or *brake shoes*, their supports and attachments, the machinery for applying the power, and a system of rods and levers to increase and transmit this. The power may be variously derived, but till recently none but hand power was employed to operate the brakes of freight cars, and as this is still the case in a vast majority of instances, and as the hand brake is the foundation of the continuous or train brake, it will be described first.

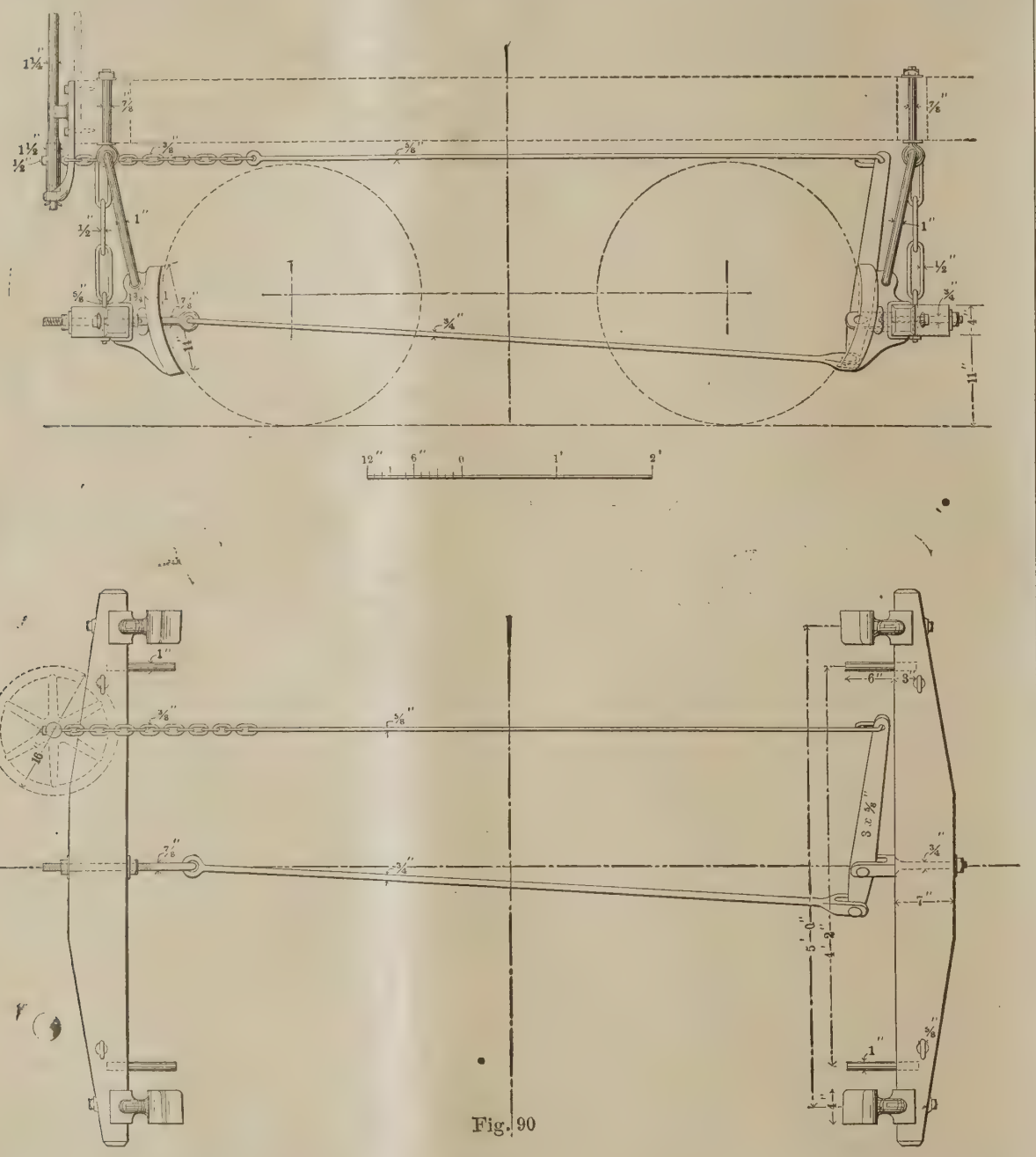


Fig. 90

Its general arrangement when applied to the wheels of one truck only, as is usual in the greater number of instances, is like that in Figs. 90 and 91, the first for brakes hung from the car body on the *outside* of the wheels, and the second for those attached to the truck and located between the wheels. Both systems of hanging brakes are pretty evenly represented and promise to remain so, as this is one of the many details it seems impossible to agree upon, notwithstanding the desirability of uniformity in this respect. The inside connected brake, although it does not decrease the number of parts, materially reduces the dimensions and weights, is also more compact, neater in appearance, and in case of a derailment or some other accident, does not injure the body of the car, as it is not directly connected with it. On the other hand, its parts are more troublesome to reach, and, although the late improvements have simplified this somewhat, it is still difficult to replace worn-out brake shoes, etc. The most serious objection to it when used with swing motion trucks is the fact that the beams are suspended from a part of the truck that is not protected by springs. This feature is said to have caused so much trouble from broken brake heads and hangers in one instance, at least, that outside brakes were again resorted to after the other kind had been adopted.

Brake shoes were formerly made of wrought-iron, but since it has been discovered that cast-iron will serve as well and is much more economical, the other material has been discarded, the last of the wrought-iron brake shoes, together with the wooden brake heads, disappearing some years ago. The cast-iron used should be preferably of a soft quality. Cast shoes have also been made with chilled faces, or alternate chilled and soft strips in these, the object being to increase the life of the shoes. They have failed, because chilled metal checks and crumbles when it becomes heated to the extent brake shoes necessarily are. The Congden shoe possesses more merit; it is also of cast-iron, but has a number of small pieces of wrought-iron inserted in its face. Its record shows a good mileage when properly constructed, but when it is attempted to use old nuts and bolt-ends from the scrap pile for insertions, it is very liable to break before it is half worn. The insertions should be small and cut from a rectangular bar in such a manner that they will not work loose. The necessity of casting this shoe with the face down and the back in the cope of the mold is a bad feature; the tendency is for the impure metal and blow-holes to concentrate in the back or weakest part of the shoe.

Brake shoes may be directly attached to the beams, but generally, to facilitate renewals and reduce the amount of scrap to a minimum, they are made separate from the *heads* which support them and also the beam, the hangers by which the whole is suspended being attached to them. But four of a numerous variety of patterns are shown. That in Fig. 90 is a combined head and shoe, which, in general outlines and dimensions, fairly represents this class as used in connection with wooden beams, the different patterns being principally caused by the difference in the methods of applying the hanger. The separate head and shoe patterns most extensively used are illustrated in the next three figures, of which that in Fig. 92—the Christie—is the standard adopted by the M. C. B. Association. Both it and the Collins, while on the whole satisfactory, have the bad feature of permitting the upper part of the shoe to drag on the wheel, the point of suspension being too far back for a proper balance, and unless proper appliances are provided to counteract this, as is not usually done, the fault results in an uneven wear of shoes. The action is as follows: Say the abrasion at the upper corner has been sufficient to shorten the face of a 14-inch shoe one inch, then the distance from the center being 6 inches to the upper and 7 inches to the lower end, the pressure and wear at these points is as 7 to 6, the short end wearing fastest. The shoe and head in Fig. 93 are better balanced, but less satisfactory in other respects; the shoe depending on comparatively small hooks or projections cast in one piece with it, becomes worthless if these should break, as they frequently do. The fit of these parts is also usually but poor and the lost motion consequently great, which is aggravated by the small surfaces in contact with hanger and pin, and productive of a rattling noise, especially objectionable on passenger cars.

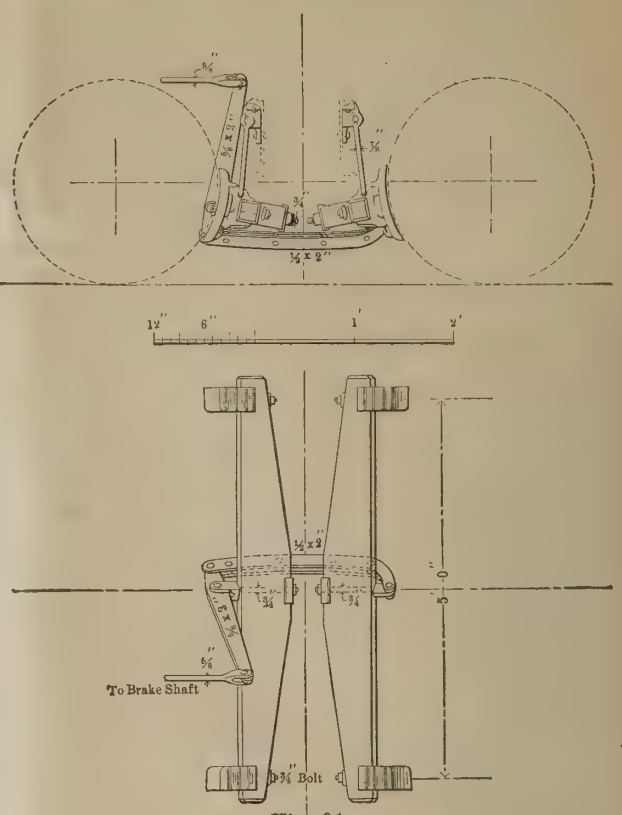


Fig. 91

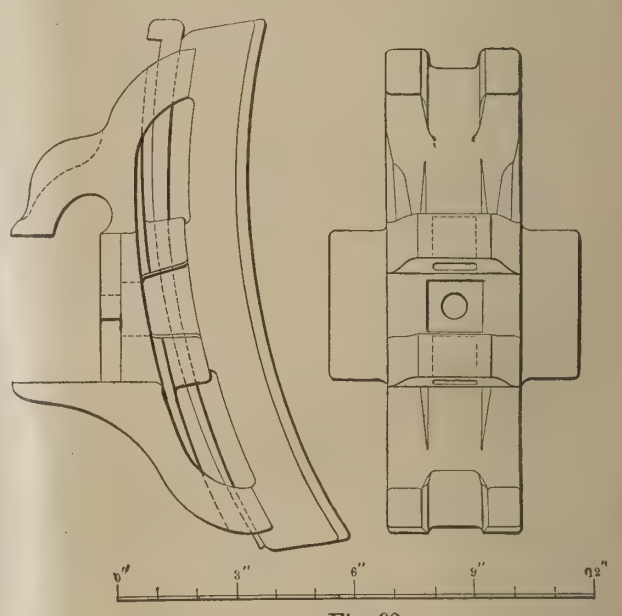


Fig. 92

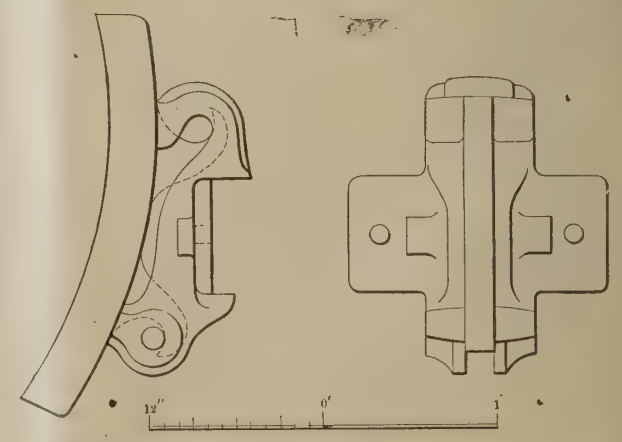


Fig. 93

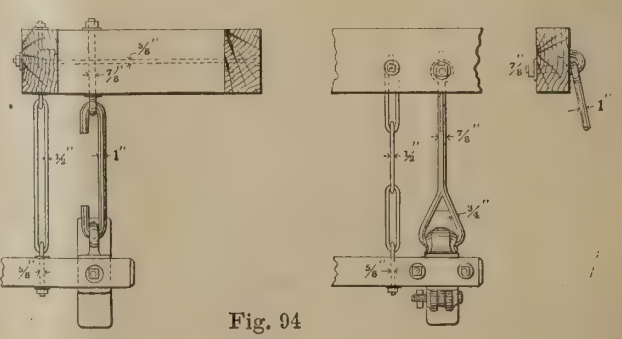


Fig. 94

Two forms of hangers used for suspending outside connected brakes are shown in Fig. 94. They are shaped from round bar iron of the dimensions marked in on the drawings, and conform on the lower end to the particular shoe used. The upper end is attached to a hard-wood block framed in between the body side and intermediate sills with double tenons and secured with a ⅞-inch rod as indicated. In many instances the truck is so placed that the hangers

next to the end of the car can be attached to the end sill, but the manner of fastening is the same in either case. The fastening is effected in the first instance through an eye-bolt and a hook shaped on the hanger, and in the second by reversing the operation, but placing the bolt horizontally. The second method is much improved by substituting an eye-bolt for the hook-bolt, as the latter is difficult to keep tight, owing to the insufficient and one-sided shoulder presented by the end of the hook.

A safety hanger is usually placed a short distance from the main hanger as a precaution, a precipitated brake-beam being liable to cause serious trouble. It is not perhaps necessary to make this as strong as the principal hanger, but it should be sufficiently so to bear the strain till the repairs can be made. The safety hanger shown consists of a three-link chain of ½-inch iron and two ⅝-inch hook or eye-

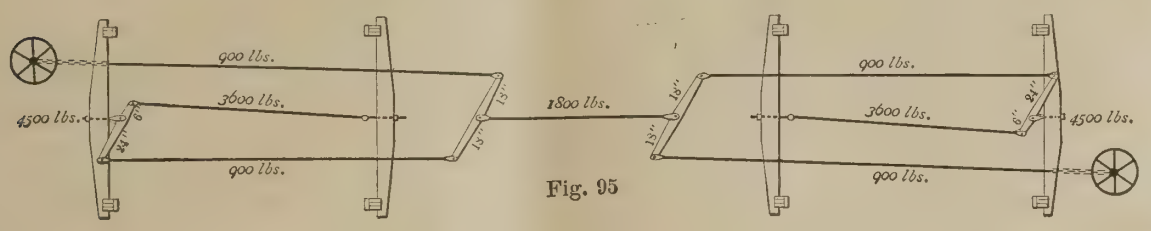


Fig. 95

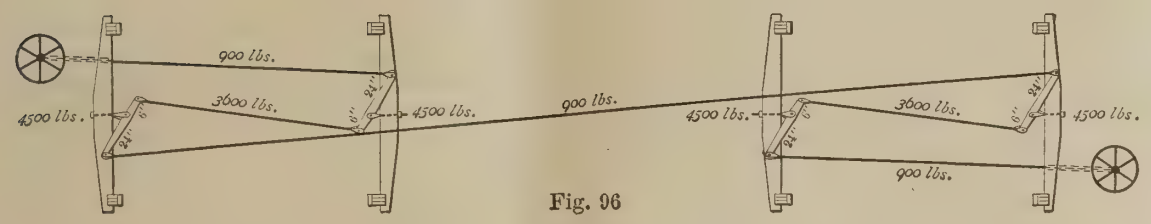


Fig. 96

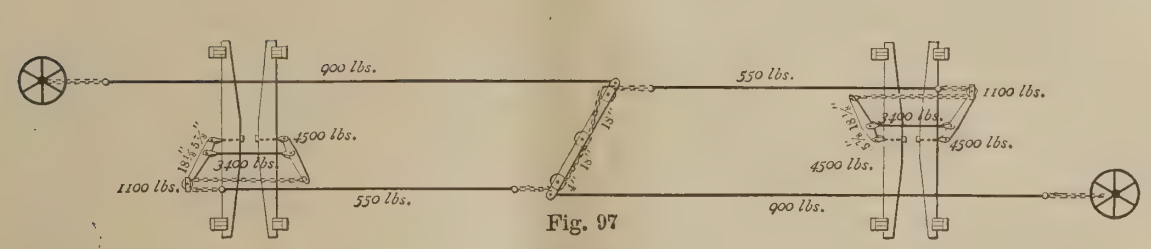


Fig. 97

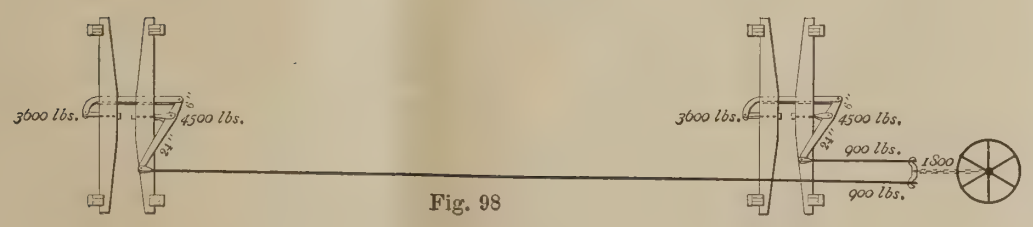


Fig. 98

bolts, which connect it with the brake-beam and timber or end sill; lag screws should not be used for this purpose.

Brake beams for *hand brakes* are of wood, both good white oak and hickory being the varieties employed. The latter is much to be preferred, but owing to its scarcity in late years, is not as frequently used as formerly. The beam is from 3½ to 4 inches thick, 7 inches wide at the center and 3¼ or 4 inches at the ends, the back edge being shaped with a parabolic curve or with straight outlines; the front edge is not touched, so as not to cut the fibres of the wood under tension. In addition to all other usual parts, the beams of outside connected brakes are equipped with wheel guards. These consist of iron pins or projections attached to the front edge of the beam about one inch distant from the back of the wheel-flanges, and serve to check its oscillations. The pins may be plain pieces of one inch round bar iron driven into close fitting holes, have threaded points like lag screws, or be forged with a collar and fastened with a nut.

The necessary pressure obtained by winding a chain on a shaft and transmitted through a system of levers and rods, is applied at the center of the brake beam, thus equally dividing it between the two shoes on the same beam. The pressure is not so equally divided between the two beams, owing to the use of but one lever. The average power a man exerts on a brake wheel is about 150 pounds, which is increased to 900 pounds by the action of the wheel and chain. This, applied at the long arm of a 30-inch lever, with the holes spaced 24 and 6 inches, exerts at the end of the short arm and on the beam directly connected with this through the lower rod, a pressure of 3,600 pounds, while that on the opposite beam, the one to which the fulcrum is attached, is 4,500 pounds or equal to the strain on both rods. This fault can be corrected only by the employment of additional parts, which are, however, not included in hand operated brakes.

The dimensions, location and manner of attaching the brake shaft were described in a former paper. The dimensions of the other parts are marked in on the drawings, which also show the usual method of connecting them. About two feet of the upper connecting rod is taken up by the chain which attaches to the shaft with a half inch eye-bolt, and at the other end with a welded eye to the rod. Both for cheapness and convenience this last connection is also frequently made with a hook precisely like that used at the lever end. The fulcrum, because of the greater strain on it, is more substantially secured to the lever. A fulcrum of cast or malleable cast-iron, fastened to the beam with two ⅝ inch bolts, is frequently used instead of the jaw-bolt shown, it being better adapted to retain the lever in its oblique position, but the jaw-bolt, if made with a square shank and properly fitted to the beam, is sufficiently reliable.

The bottom rod, referring to Fig. 90, attaches to the lever with a jaw and ⅝-inch coupling pin like the fulcrum, and to the opposite brake beam with an eye-bolt with sufficient length of screw thread to apply a checknut on the inner edge of the beam and to allow for taking up slack as the shoes wear away. For inside brakes the lower connection, being subjected to compression instead of tension, is made the proper stiffness by building it up from two pieces of flat bar iron separated by packing pieces and joined by rivets, the jaws thus formed connecting with the lever at one end and an eye or strap bolt at the other. When brakes are fitted with a second or dead lever, the lower connection, then being straight, may be made of malleable cast-iron.

When brakes are applied to both trucks of a car they should be and generally are so connected that all the shoes can be operated upon at once and by one hand wheel, although there may be a wheel placed at each end of the car as a matter of convenience. The leading methods of arranging the levers and rods are roughly sketched in Figs. 95 to 98, the details being mere repetitions of those just described.

Two of the figures show outside and the remaining inside connected brakes, but all of them can be readily altered for which ever is desired, and all but that in Fig. 98 may have either one or two hand wheels. This latter can be set from but one end unless an extra lever is added, in which case the simplicity aimed at would not be produced. This system is also deficient in leverage as ordinarily constructed; the short arm of a 30-inch truck lever would have to be 3 inches to give the same power as either of the others possess, and as this is too short to work well in practice, the difference must be made up by employing a larger hand wheel.

The length of the levers and the strains coming on the different parts—assuming the initial power to be 150 pounds—are marked in on the drawings.

Wants to Put the Locomotive Behind.

An inventor hailing from Kansas City has made all arrangements for placing the locomotive at the hind end of every passenger train instead of leading the way as at present. The advantages this inventor is prepared to offer to the railroad companies that adopt his plan is, the removing of the annoyance from cinders and smoke that is now inflicted upon passengers. He proposes to fit up an apparatus in the front of each train which will, by means of electrical connections, enable an operator to handle the engine behind as promptly as if his hands were there to grasp the throttle lever, the reverse lever and other connections. We have heard before of proposals to remove the locomotive to the back end of the train, but we never saw so many provisions made to overcome the most apparent objections to the scheme. The Kansas City inventor is prepared to give all the advantages the existing system gives of the engineer being in a prominent place to perceive urgent need for stopping quickly, but there are some dangers from having the locomotive behind which he has not provided against. In nearly all foreign countries and in several of our States there are laws that prohibit the use of a locomotive behind a train. Such laws were enacted as measures of safety, because experience had demonstrated that a locomotive pushing a train was apt to act as a destructive battering ram on the cars in case of anything happening to derail the forward cars. There are several other disadvantages connected with having the locomotive behind the train that we need not point out, because it is never likely to go there.

The proper remedy for the smoke and cinder in the eye nuisance is the exercise of more care in preventing them from annoying passengers where the engine is in front. When those responsible for the running of locomotives make intelligent and sensible efforts to have the engines operated in a cleanly fashion, the people have no reason to complain of smoke and cinders.

"Agin the Railroads."

We are indebted to Mr. E. C. Kinney, of the Union Pacific Railway, for the following concise but lucid explanation of the source of many of the granger railway difficulties, which is cut from a letter of an aggrieved resident to the *Madisonian:*

For some weeks past my dog has been in the habit of sicking himself unto the cars as they sped apast my place, and he never harmed no one by so doing, nor never would, as I have known him from a child, being peaceful and fond of young children and awful from the butcher's shop, or would set up and beg or ask for what he requested at any time. When he would run at the cars he would act savage, but still would never injure the train by word or deed if I had a hundred trains whizzing past my place I know he would not harm any of them by night or day, but what does the fireman on the Manitoba-Madison Pacific Northern Utah Railroad do but urge my dog to a high rate of speed and whistle to him to get him close, and then pelt him with wood or coal, or squirt hot water on him, which he tells me, in a blithe and gay tone, that makes me hot, he does to take the bark of my dog. That is what makes me hait the railroad—and that is not all by a long chock, for yesterday they misled my dog and got him in front of the engine when they pulled her wide open and squashed my dog in a way that hurts the rode, and causes it to be looked at askance by every thinking taxpayer and mother. Why will we submit? And also they have killed one child, as they claim by mistake, for which they paid $150, which is no price at all for a child as children goes, and is almost like finnin' a child in the rode. I say fy on such a rode as that, with its sandwiches, which has just a thin rim of ham around the aige, so's when you lock your teeth into it you get left, and the rode has got your money and your name is Dennis, as we say here. Fy on the whole thing is what I say, and I wish you'd print it for I don't care who knows it.—*Engineering News.*

A daily paper gave an illustration the other day purporting to be a likeness of a steel car that is under construction in Chicago. Ever since an evening journal used a worn out electrotype of the murderer Guiteau and pretended that it was a likeness of the editor of this paper, we have never taken any stock in the illustrations of the daily papers, but if the coming steel car is to have any resemblance to the cut referred to, it will appear very much like an overgrown English hay mow.

Communications.

Interfering With Standards.

Editor National Car and Locomotive Builder:

You have a standing announcement which informs your readers that "articles relating to railway rolling stock, construction and management, and kindred topics, by those who are practically acquainted with the subjects, are especially desired." I accept that as an invitation, and I will write you something that you may class under kindred topics, as I want to defend the standards of the Master Car Builders' Association. A paper which I read regularly had this month an article savagely attacking the Master Car Builder's oil box. Is that wise? Is an action of the kind likely to be of benefit to railroad companies at large? I doubt it. The oil box now in use was very carefully considered before it was made standard, and it was the best box in use and has done good service. There is nothing about cars that cannot be found fault with, and the oil box is not an exception. It does its work very well. It costs little, it seldom breaks and it makes a good secure housing for the journal and bearing. The only thing against it is that it is not oil or dust tight at the dust guard. But whose fault is this? If a dust tight dust guard is all at once considered so very necessary, why do those who want it not make one dust tight and put it on a standard box? No, that is not what they want. They want a patented thing that will drain money out of the pockets of railroad companies. Papers that get out articles about oil boxes and making little of other standards are only following in the wake of silly talk that is to be heard at club meetings and other places. It would set them all better to be saying something good about things, and not be underrating their neighbors' chattels and oil boxes.

What were standards made for but to be kept like the ten commandments and not broken like piecrust? You said once in my remembrance that a poor standard was better than no standard, and why belittle the oil box? On the same reasoning a box that is not according to the idea of perfection that everybody has is better than some fancy box that only one or two master car builders have ever heard about. As some one else has said, I like consistency, and it is not consistent for railroad men to talk against standards that they have plainly and openly voted for, now that they want a change to please fancies that do not find a place in the minds of the car builders who do their work with the least jarring.

The men who want to change away from standards and bring confusion ought to turn their minds back to the time when every man used anything that suited his fancy. Was there any complaint those days of standards not being good enough? Not much. When you had to make bolts to repair a foreign car before it could be got out of the yard, you were glad when standard bolts and nuts came in. The next thing will be, if we give in, to break the standard on the axle box, that some one will want to change the threads of nuts and bolts. I say union is strength, and we ought to remain united against monkeying with standards.

Old Car Builder.

Shortcomings of Freight Car Trucks.

Editor National Car and Locomotive Builder:

You find a great many shortcomings to the common oil-box. Some car men will not agree with the remarks you make on this head in last Car Builder, but I am with you in every word said. It is time we were making some progress. The present oil-box is all right for trains running 15 miles an hour, the common speed of trains when the box was selected as a pattern for all roads. Things are very much changed now, and the running gear of cars ought to be changed accordingly.

I am convinced that a better form of box is wanted, and also a better kind of truck to hold the box. You say that "it would be hard to find any component part of rolling stock performing important functions with so few merits to recommend it." My own belief is that the oil-box is a very respectable member of the truck that it generally runs in. Let us give the devil his due, as he is represented in the diamond truck. The diamond truck is cheap, and holds together wonderfully, considering the usage it has to stand. I cannot think of any other good point that the truck has. The truck as ordinarily constructed is hard on its own parts and destructive to the track that it runs upon. It also possesses inherent faults of design that will always make it hard on the track.

The essential duty of a truck is to make the weight of a car rest on the wheels in a way that will carry the vehicle along with the least possible resistance, and with the smallest possible damage to wheels and track. To do this, the wheels must be held so that the axles are parallel and the wheels on each side made to revolve in parallel vertical planes at right angles to the axles. The diamond truck never comes nearer than an approximation of this performance; and in most cases the approximation is far from being a close one. There are few of the frames that with the axles will form a true rectangle. Owing to the rough work done in fitting the arch bars and in drilling them, it is very seldom that the two sides are within $\frac{1}{8}$ inch of being the same length between centers of the boxes. Often it is considerably more. If the variations happen to be all in one direction, throwing the wedges all forward or all backward, the truck will not be very much distorted, if the amount of variation in the boxes happens to be about the same quantity. But if the variations in the two sides are opposed to each other, we have a badly distorted truck which may be over an inch out of true. This happens when by bad fitting the wedges on the boxes on one side are placed nearer together than they should be, and those on the other side are forced apart. When a truck is in this condition the wheels incline to run to the side instead of keeping right along following the rail. This puts the wheels to work grinding down the flanges on the side of the rail head, and the work that causes rapid destruction of wheels and rails greatly increases the resistance of the car to traction. The whole thing means more repairs on rolling stock, and more expense for the freight hauled. The defects of construction that cause the wheel flanges to run toward the rail head make the wheels roll with an oscillatory motion, the flanges on the two sides taking alternate turns in bumping up against the rail head. This increases the resistance, wears flanges and rail, distorts the truck still worse, wears the bearing and journal, and throws the oil out of the boxes.

If the arch bars should happen to be drilled so that they would hold the axles nearly parallel, the chances are that the advantage of this accuracy will be lost by the rough castings that form the box and wedge.

You have discussed the shortcomings of the standard oil box, so I shall not touch on it further. It is assumed, however, that an improved form of oil-box is necessary. Now the point I wish to make is, that there is no use in changing the box without making a radical change in the whole truck. You may say that better workmanship would effect a remedy for the admitted shortcomings of the diamond truck, but that would only help things a little. The form is bad. You connect two trusses in the middle by a beam and set the wheels to pounding at the unsupported ends of the trusses. How can you expect such a structure to keep square? It never can be kept square under the existing loads and train speeds. Why is it that all well managed railroads prohibit the running of freight cars with diamond trucks on passenger trains? Because they are not safe to run at high speed. Therefore it is time that some thing better was designed for all trains. Apart from the impossibility of keeping it square, there is too much of the diamond truck unsupported by springs to be suitable for high speed trains.

An acceptable truck worthy of present ideas of progress, and capable of carrying the loads becoming common, should be of the very strongest material available, put up in its strongest and lightest form. It should be so designed that a blow from the wheel on one side would be resisted by both sides of the truck. The oil boxes should be held so that they would keep the axles parallel, and the boxes being the corner points of a rectangle—not of a trapezoid. And springs or equalizers connecting with springs should rest on the oil boxes.

A truck having all these essentials could be designed. It would cost a little more at first than a diamond truck, but its superiority in reducing tractive resistance and in saving wear and tear would bring in a big return on the additional first cost.

A. M. L.

Center Support Trucks.

Editor National Car and Locomotive Builder:

It is now six years since the Finlay center support truck for three-truck cars was invented and put to practical use. They were first put on the Hot Springs Railway of Arkansas. This system of running gear has been illustrated and commented on on various occasions in your paper. After seeing the model at the M. C. B. and M. M. conventions, a number of these cars have been in service on the road named to this day, in mixed passenger and freight trains, running daily over its heavy grades and 16-degree curves, thus demonstrating beyond question this system's absolute safety in speed on that road up to 35 or 40 miles per hour, and carrying 15 to 25 tons per car when in these mixed trains. The first delay or accident on account of this system has yet to occur. Now, Mr. Editor, what greater or more conclusive proof of its reliability and safety can be wanted or given for this system of running gear? Yet this valuable factor of safety to railroads is in use only to a very limited extent as yet. The Pennsylvania Company has adopted it and has a number of three-truck 40 and 50 ton dump cars in their ore service, as also has the Lake Shore & Michigan Southern Railway. The Missouri Pacific has a number under 30-ton ore and granite cars, and there are a few scattering three-truck cars in use on other roads, all of which are reported as giving great satisfaction. Of course, this system of car is only required for very heavy capacity cars, or where extra precaution against accident from broken trucks should be taken, such as under long coaches, sleepers, mail and baggage cars, or *circus* cars. No matter how many wheels are in the end trucks; they do not give that factor of safety that the three-truck car possesses. It may not have occurred to a great many of our railroad officials that one of the great factors of safety in a three-truck car is that should either of the end trucks meet with an accident and break down, that the car would be carried on the two remaining trucks in safety until such time as it could be set aside off the main line. Now, referring to the accident to this circus train, of which I enclose the newspaper report, had this car been on three trucks no such accident could have occurred. Yet year after year we read of the trucks under circus train cars breaking down, and causing horrible wrecks and loss of life and property that no money can restore.

I write this communication to you thinking that it is a proper one to call your attention to under articles on rolling stock. True, I am interested, in a financial sense, in this system of car; but I am also interested, as I know you are, in trying to protect our fellow-beings from such horrors as yearly occur to those circus trains.

L. Finlay.

Interchange of Cars.

Editor National Car and Locomotive Builder:

I notice that the Master Car Builders have decided to consider a system of Joint Car Inspection at their next meeting, and being considerably interested in this question, I would like to see and participate in a discussion of this matter through the columns of your valuable paper, with your permission.

I am of the opinion that it is a knotty question to handle, that is, when points of importance are considered.

By points of importance I mean an interchange point of 40,000 or 50,000 cars per month.

The following questions are open for consideration:

1. Why is it necessary to have a Joint Inspection?

2. Should a Joint Inspector have full charge of all the men engaged in the inspection and repairs of cars at the point at which he officiates for the various roads? If so, why?

3. Should he be selected to fill the position from one of the roads for which he is expected to officiate, or should he come to the position an entire stranger, not previously connected with either road?

4. Should he be permitted to use his own judgment in the interchange of cars, or be governed by the M. C. B. rules?

5. If governed by M. C. B. rules, what is the use of joint inspection?

6. If he uses his own judgment, what is the use of M. C. B. rules?

7. Would he be capable of filling the position if confidence could not be placed in his judgment?

8. Should his decision in all cases pertaining to defects be final?

9. Would it be good policy for one man to control an interchange point such as mentioned above?

An answer to the above will greatly oblige.

J. E.

Balanced Pistons.

Editor National Car and Locomotive Builder:

The hot weather and some time devoted to my annual rusticating has made me neglect my reading, and owing to that it was only yesterday that I noticed, in looking over the July number of the Car Builder, that an illustration is given of a rather ingenious attempt to balance the piston of a locomotive cylinder. Many attempts of the same kind have been made before, but no demand has arisen for making use of the inventions, so that really the piston does little harm by using the bottom of the cylinder as a guide. About ten years ago a firm of engine builders in England made quite a sensation about the loss of power that resulted from the piston dragging in the cylinder, and they were ready with a remedy. This consisted of a curved piston-rod, which tended to act as a lever and pry the piston up. The gland, of course, became the fulcrum, and received the wear, but means to take up the wear could be applied to the gland.

There was a good deal of humbug about the whole thing, and the remedy seemed worse than the disease. It was much like the man who mended a dog's broken leg and broke two others during the process. The engine firm made nothing of their invention.

When adjustable spring packing came first into use, some bright mechanic suggested the use of an extra strong spring for the bottom one to prevent drop. Some of our engine building firms have made the claim that in their engines the tendency of the pistons to cut the bottom of the cylinders is compensated for by lifting springs within the piston. One might as well put springs in his shoes with the expectation that they would prevent him from bearing so much weight on the ground.

Twenty-five or thirty years ago an Englishman invented an arrangement in which the cylinder had a broad groove cut lengthwise in its bottom. In this groove was placed a rib or stave. The rib was bored out with the cylinder, and being adjusted vertically, it could be set up as it wore away. It was an independent guide placed in the bottom of the cylinder, and it was provided with wedges and screws for adjusting it without removing the cylinder head. It was applied to very few engines.

About fifteen years ago a railroad man in this country named Findlay tried a scheme for taking up the weight of the pistons that was in many respects similar to the plan which you illustrate in the July number. Findlay weighed the piston and rod, deducted half of the weight of the rod and noted the result, say 225 pounds. He then calculated

the pressure of steam usually carried. He then cut shallow recesses in the bottom edge of the spider flange and follower proportioned to the pressure required to hold the piston up, and drilled holes in the piston faces to admit steam to the recesses. By a little experimenting he succeeded in so proportioning the recesses and the admission of steam that the piston was kept floating on a film of steam. It worked nicely, but there never was any demand for it I hope your Pacific Coast man may meet with greater patronage than was extended to Findlay's invention.

JOHN LITTLE.

Friction and Lubrication.

Friction is a resisting force which always acts to prevent or retard the motion of bodies in contact. It retards the motion of machinery, and by the friction of journals turning against their bearing; by the friction of the wheels rolling upon the rails, and of their flanges against the rails; by the friction of the air against the exposed surfaces of engines and cars in motion, the speed of trains is retarded and finally limited.

The work of friction, therefore, is a matter of importance to engineers, for the reason that it absorbs and wastes a seriously large amount of the available energy of locomotives, and converts all energy so diverted from useful work into *heat*, which may give rise to inconvenience and delay, and injury and even destruction of moving parts.

In all cases the action of friction in the machinery and rubbing parts of an engine results *in increase of the effort required to drive it;* so, not only to prevent wearing and injury to the surfaces in contact, but to be economical in the use of power, friction must always be reduced to the lowest possible degree. This devolves upon the engineer, and may be effected by a judicious use of the lubricating oils with which his engine is supplied.

The objects of lubrication are to reduce friction and prevent the development of heat, and are accomplished by interposing between the smooth rubbing surfaces of machinery and journals and bearings, a film of oil of sufficient "body" to keep the surfaces between which it is interposed from coming together, so that the rubbing parts nowhere, and at no time come into metallic contact.

The use of more oil than is necessary to effect this purpose is an unnecessary waste, and should be avoided.

To do which the first condition necessary to observe is the *temperature* of the oil to be applied. It should not be greater than is necessary to allow the oil to flow freely from the spout of the oiling-can, which it will generally do at a temperature of 80 degrees, or 20 degrees below blood heat, which is 100 degrees. It should not be applied hotter than this for several reasons: one of which is, it will be so thin, especially in summer, or when applied to hot surfaces, that it will not adhere sufficiently to the surfaces it is interposed between so as to prevent friction, but will, under heavy pressures, be forced in part from between them. Another reason is: it will run off from the tops of driving boxes and engine trucks, and from surfaces it is intended to lubricate, faster than if it was less warm and thin. "The greater the consistency of the lubricant, other things being equal, the greater the endurance and economy."

Temperature affects the lubricating quality of oil and the friction of rubbing surfaces vary greatly.

Friction.—Friction increases rapidly when the temperature of the surfaces in contact is greater than 90°. In this we find another reason why oil should not be applied to the surfaces it is intended to lubricate when it is warmer than about 80 degrees, because one duty of the lubricant is to absorb and carry off the heat generated by friction, and if the lubricant be warmer than the temperature named, it must fail in this duty, and if it be hotter than 90 degrees it adds undeniable heat to the surfaces it comes in contact with.

From all of which it must be plain that the common practice of carrying oil cans close against the boiler-head in warm weather, where the oil they contain becomes heated to the temperature of 140 or 160 degrees, and then using this hot oil for the purpose of lubrication, is not only wasteful of oil, but a bad practice generally, and liable to be (and often is) attended by the inconvenience and delay due to heated journals or other parts, and the loss of power connected with it. One "hot box" on engine or train noticeably affects the coal pile.

When the shelf attached to the boiler head is the only place provided for carrying oiling cans, the temperature of the oil should be cooled to about 80 degrees before being used, by dipping the can in water.

In using engine oil in cold weather that will not flow freely, it is best to dilute it sufficiently with kerosene in order to make it of the proper consistency rather than heat it to a high temperature.

When used heated instead of diluted sufficiently, its heat is absorbed immediately it touches the cold metal surface it is applied to, and it congeals and takes the form of grease, and is then not so good a lubricant by far as when in the liquid state.

Indeed, to be a proper lubricant, it must be in the liquid state; when not, friction exists between the sticky layers of grease adhering to the metal surfaces and passing over one another. This friction, which is called "the friction of fluids," acts nearly the same as the friction of solids, and retards motion, making greater power necessary to run the engine.

Generally in mills and shops the engine and machinery are started running several minutes before the time to commence work in order to get everything "warmed up." This is made necessary by the retarding force of the friction of the lubricating material lying between the rubbing surfaces of the machinery in a congealed state.

By the way trains drag for the next few miles after a delay of thirty minutes in cold weather, enginemen are made painfully aware of the action of friction in the congealed oil lubricating the journals of the engine and cars constituting the train.

For this reason it is best to use only signal oil in freezing weather to lubricate the valve gear, except the eccentrics and link-blocks, and the heavy valve or cylinder oil should only be used on steam cylinders, or on hot surfaces.

Oiling should be invariably attended to before the commencement of every trip. Every movable part and every oil-hole should receive its share of attention and oil. Oil-holes stopped up should be promptly and thoroughly cleaned.

Driving boxes, wedges, engine trucks, and the valve gear, except eccentrics and link blocks, generally need oiling only once every 50 or 60 miles. The eccentrics (when not equipped with cups), link blocks, guides, piston-rods, and front end of main rod (with open cups), need attention about every 30 miles. Three pints of "engine oil" per run of 100 miles is generally sufficient. A squirt can should be used to oil the valve gear (except eccentrics and link blocks), and regular oiling can to oil other parts. Oil cans with leaking bottoms and broken spouts should not be used while in that condition, but should be repaired as soon as possible.

All rod cups should be filled before starting out on any trip, and covers secured. Main-rod cups should be adjusted to feed over half a cupful of oil per trip of 100 miles, and side-rod cups over half a cupful per trip of 200 miles.

Guide cups should be kept covered and clean, and should be adjusted to feed only an amount of oil necessary to keep the rubbing surfaces of guides and cross-heads well lubricated, judging from their appearance. The feed should be closed when delayed any considerable time at stations, and at the end of each trip.

Only the oil employed for that purpose should be used for lubricating valves and cylinders, and no more of it than is necessary. With sight-feed lubricators and cylinders 16 × 24 to 18 × 24, from two to four drops of oil per minute is sufficient for proper lubrication; with larger cylinders five or six drops per minute may be necessary. More than this is an unnecessary waste. On engines where steam must be shut off to oil the valves and cylinders, an amount of oil equal to two tablespoonfuls for each side, supplied every fifteen or twenty miles, is sufficient. Only an amount of oil that can *adhere* to the internal rubbing surfaces is of any use; all supplied in excess of that amount is worse than wasted, for it is carried from the cylinders in the exhaust steam, much of it adhering to the exhaust pipes and nozzles, and forming a gum which acts mischievously in choking the free escape of the exhaust, which causes back pressure in the cylinders.

It is very important, in studying the economical use of power, to study also the proper and economical use of lubricating oils. The former depends greatly upon the latter, and every movable part should be kept well lubricated with oil, the temperature and consistency of which has been carefully prepared to suit the conditions of its actual use.

Much depending, then, upon proper lubrication, "oiling around" should never be done hurriedly, but carefully and deliberately, looking well to the general condition of the engine, the temperature of journals, pins, eccentrics and the appearance of lubricated surfaces.—*George H. Baker's Manual of Instruction.*

The Hammer Blow Again.

Parties interested in the Shaw locomotive, who have displayed extraordinary persistency in forcing their pet form of engine upon the attention of the public, are working up a new scheme. They are about to send out to railroad companies lists soliciting subscriptions to defray the expense of making a series of experiments to demonstrate the intensity of the blows transmitted to the rails by the action of the unbalanced parts of a locomotive. Railroad companies do not require to undertake any new and expensive experiments to ascertain the extent of the so-called hammer blow. Many railroad companies have repeatedly ascertained that for themselves, and the thing is no mystery. It is one of the things whose existence and extent is much easier demonstrated than remedied. There is one thing certain. Most railroad companies will be contented to struggle along laboring under the disadvantages of the hammer rather than try to remedy them by inviting the new sources of accidents, annoyance and expense that would be entailed by the adoption of locomotives of the Shaw four-cylinder type.

A car for carrying blooms and billets to the rolls is in operation at the American Iron and Steel Works of Jones & Laughlins, Pittsburgh, which is likely to supersede the cumbersome tables now in use. The car has a flat chilled iron bed, is operated from below by a cable, and is much safer for the men working about the rolls than the old method.

It is reported that some qualities of luminous paint made in Europe act so well, that in the inside of cars covered with it sufficient light is given off at night to enable passengers to read. What a boon it would be to the traveling public if American railroad companies would use paint of this kind in the inside of their cars.

The New York Central have lately arranged to apply the Westinghouse air system of signaling to all their passenger trains. They have experimented with electrical and various forms of train signals, but have now decided that air is more reliable than anything yet invented for the purpose. They are also introducing gas from petroleum as a means of lighting their passenger trains.

Angus Sinclair. secretary of the American Railway Master Mechanics' Association, has issued the following notice to members and others interested: "I expect to sail for Europe on Sept. 25, to be absent seven weeks. I have to request members who have business to transact with this office to postpone it till I return, and if this cannot conveniently be done, to submit it to President Briggs, Memphis, Tenn."

The Annual Convention of the Brotherhood of Locomotive Engineers will be held in Denver this month. The most important business of the Convention will be the election of the Grand Chief and the deciding on where the headquarters of the organization will be after Jan. 1, 1890. There is considerable dissatisfaction among many members of the Brotherhood about the outcome of the C., B. & Q. strike, and there is a desire to put the blame on Grand Chief Arthur. This may lead to some opposition to the election of the officer who has been so long at the head of the Brotherhood, but it is not likely to prove very formidable.

Two engineers representing the Indian Government were at Lima, O., some days' investigating the process in use for producing and handling oil. They were G. B. Reynolds, of Bombay, and R. A. Townsend, of Beloochistan. They are looking into the methods of transportation of crude petroleum, with a view of contracting for necessary machinery, tank cars and storage tanks to go to India. The oil districts of Asia have not as yet been developed to any great extent, but will now be pushed by the Government. The crude oil will be used as fuel at first, but may be refined later on. They were greatly interested in the operation of the enormous pump at the Standard's Chicago station.

The Weems Electric Railway Company have been running cars at exceedingly high speed on an experimental railway near a branch of the B. & O. between Washington and Baltimore. The track is circular, and is only two miles long, and is traversed by an experimental train weighing 6,000 pounds. The motor and cars form a compact body pointed at each end to diminish the resistance to and suction on the atmosphere. There is good reason to believe that this train has been run at the rate of two miles a minute. It is, of course, spoken of as the passenger locomotion of the future. Those interested in this motor expect soon to put that system into practical operation in transporting mail matter and small packages.

The imperial train in which the Czar of Russia travels during his railroad journeys was badly wrecked in an accident some time ago, and although the cars were constructed with a view to making them safe, even in a collision, they went to pieces badly, and the Russian empire nearly lost its head. A new imperial train has now been built, and every precaution has been taken to make the cars perfect in strength and luxurious furnishing. The saloons are covered with iron outside, and then comes eight inches of cork instead of the steel plates with which the carriages of the old train were protected. All the saloons, which communicate by covered passages, are exactly the same in outward appearance, so that no outsider may be able to discover it is the carriage the Czar is traveling in.

A circular from Mr. C. A. Hammond, secretary, announces that the Association of North American Railroad Superintendents will hold their eighteenth meeting at the Hotel Brunswick, New York, beginning on October 7. There is an unusually attractive programme, which, besides routine business, includes: Report of Committee on Roadway, J. B. Morford, chairman—On award of prize for best treatise on trackwork, etc.; on rail sections. Report of Committee on Machinery, G. W. Beach, chairman—On steam heating of trains; on train signal apparatus. Report of Committee on Transportation, Robert Blee, chairman—On uniform forms for time tables; on methods of discipline. Report of Special Committee on Rooms and Headquarters, C. W. Bradley, acting chairman. Report of Special Committee on Relations with General Time Convention, President Gadsden, chairman, *ex officio.* The reading of papers on special subjects. Shall the Association adopt the amended form of Constitution proposed at last meeting? Shall the Association establish formal relations with other organizations of railroad men?

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EDITORIAL ANNOUNCEMENTS.

Advertisements.—*Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING COLUMNS. *The editorial department will contain our own views and opinions; and the rest of the reading matter, aside from advertisements, will be such as we consider of interest to our readers.*

Contributions.—*Articles relating to railway rolling stock construction and management, and kindred topics, by those who are practically acquainted with these subjects, are especially desired. Also early notices of changes in railroad officers, organizations and names of companies.*

Special Notice.—*As the* CAR AND LOCOMOTIVE BUILDER *is printed and ready for mailing on the last day of the month, advertisements, correspondence, etc., intended for insertion, must be received not later than the 25th day of each month.*

To Subscribers.—*We occasionally receive complaints from subscribers that their paper is not received regularly. When cause for such a complaint exists, the blame lies with the mails or with the method of delivery, for the paper is mailed regularly to every subscriber each month without mistake. Any subscriber who fails to receive his paper ought at once to notify the postmaster at the office of delivery. When a subscriber changes his address he ought to notify this office at once, so that the paper may be sent to the proper destination.*

To Prevent Railroad Accidents.

We are very far from being inclined to act the part of alarmists, but it appears to us that the number of railroad accidents reported every week is becoming appalling. We have not had lately any civil massacre like the Bussey Bridge disaster, where the attention of the whole world is likely to be directed to the scene of the catastrophe; but week after week there appears to be an increasing record of accidents where a few persons are killed and others injured. Dividing the accidents over a large territory prevents the public from realizing the extent of the destruction to life and property that is constantly going on. The *Engineering News* follows the practice each week of giving the leading facts and making brief comments on the most conspicuous railroad accidents of the past week. Since beginning to write, we took up at random and looked over five copies of the paper named, and found that 45 deaths had been caused by the accidents enumerated in the five weeks. This is terrible, yet it is far from being a complete record of the death and suffering that resulted from railroad accidents in the brief period.

When a particularly sanguinary accident has happened by the failure of a bridge or from any other clearly-defined cause, it generally has done some good as a preventive of other accidents, by stirring up the officials on other railroads to apply timely remedies; but a distressing feature about the minor accidents that make up a terrible aggregate of slaughter by the end of a year is, that they exert no good influence in preventing similar accidents due to analagous causes. This results from there being no intelligent and systematic plan followed of investigating accidents, and publishing clear statements of their cause. This duty is left to coroner's juries, and the men called to perform this duty have no skill or experience that fits them to investigate the causes of accidents properly, and the result is that in cases where death has been caused by criminal negligence, the investigation very rarely puts the blame where it rightly belongs, or brings out clearly the individuals on whom the real responsibility rests. When a case goes into the courts, and men are put on trial for criminal negligence, they almost invariably escape punishment, because there has been no expert investigation of the accident, and lawyers can raise doubts in the minds of the jury as to where the responsibility rightly belongs.

The most sensible and rational way to begin working out a remedy for this condition of affairs would, we think, be in the appointment by the Inter-state Commerce Commission, of officers invested with the duty of investigating and reporting on all accidents resulting in loss of life. In European countries, where the life of citizens engaged in peaceful pursuits is regarded as being much more sacred than it is among us, the work of government inspectors of railroads has been found very efficient in preventing accidents. Men who are, month after month and year after year, engaged in finding out the causes of accidents become highly expert in the business, and they soon accumulate records of cases where it is found that similar causes produce similar effects; that, for instance, reckless practices in train moving on one road is certain to bring about the same kind of accidents that happened on another road operated in a similar manner, and the notice from an inspector that accidents are likely to happen unless new precautions are taken nearly always produces remedies.

Where trains are numerous on a railroad, more perfected appliances and a more elaborate system of operating are necessary than what may safely be employed on another road doing one-tenth of the business. But there are always in this country some railroads that are in transition from the primordial to the modern period of development, and managers are nearly always inclined to lag behind in the introduction of appliances suitable for growing traffic. The representations of an Inter-state Commerce Inspector would do a great deal to accelerate the introduction of safety appliances in such cases, and his experience and matured judgment would often be the means of saving railroad companies the expense of experimenting with appliances sometimes demanded by panic legislation. The duties performed by the government inspectors of steam vessels have been the means of saving a great deal of valuable property for persons who had no desire for the supervision of such officers, and their work has undoubtedly prevented great loss of life and suffering. It appears to us that government inspectors of railroads would perform work even more valuable than the duties done by steamboat inspectors. The persons who travel by land are far more numerous than those who travel by water, and it is only fair and just that all possible care should be exercised to preserve the greater number from suffering and death.

Helps to Getting on in the Business.

The editor of this paper recently received a letter from a bright young machinist complaining about the unsatisfactory prospect there is for a good mechanic, who has striven with admitted success to become a first-class workman. This young man is a good representative of his class and has a grievance which applies to many others. He is acknowledged to be a first-class machinist, and although less than ten years at the trade, has been for three years a gang boss, and is receiving equal to the best pay of the shop. This is the top of the tree for a workman, but he is not satisfied with it, and bewails the small prospect there is for advancement, and incidentally remarks that he might have done much better in some other business. About this we are very doubtful. There is a tendency among mechanics to look with envy upon the dapper clerk, who never needs to soil his hands, and can always go about with a starched shirt on, but the lot of the mechanic is by all odds the more fortunate of the two. The clerk who is receiving $60 or $70 a month ten years after beginning the business is fortunate beyond the average of his class. If anything happens to make the clerk lose his situation he is almost certain to be long in finding another position. The supply of clerks being chronically away beyond the demand, those who are in the business have habitually to put up with petty tyranny and acts of injustice that no mechanic would for a day endure. In the course of the struggles of a somewhat chequered life the writer has worked as a clerk and as a mechanic in different places and periods, and he cannot conceive of any working life more exempt from the small vexations and annoyances that take the sunshine out of employment than that enjoyed by a good mechanic.

So far as "getting on" is concerned, which means becoming more than an ordinary workman or common clerk, the great mass of the employed remain doing the ordinary run of work all their lives, and it is generally the possession of some special capability or special attainment that recommends a workman for promotion to the position of foreman. Men are often advanced to take charge of work who have no real fitness for the position; but those who are responsible for this are generally the ultimate sufferers. When a mechanic becomes noted in a shop as an expert workman, he considers that he ought to be selected for promotion in preference to others who have displayed less artisan skill. This is a mistake, and superintendents have had many expensive lessons to teach them this truth. A first-class close workman who takes great pride in doing every job as if it were a work of art, is likely to be a poor foreman, because he cannot endure to see anything passed on as finished if it is not as well done as he would do it himself. In most shops the mass of the work must pass as well enough for the purpose when it is far from being perfect. It is often waste of labor to put finish on work that the close mechanic is constantly inclined to fall into the mistake of putting upon it. In cases of this kind the superskilled workman is likely to prove an inferior foreman. What is necessary more than superior skill is superior judgment. The man who selects the foreman must be the judge of that.

Of two men, one a first-class mechanic with a passion for having work done in the best possible style, and the other a commonplace workman with keen perceptions as to the utility of work, the latter will make the better foreman every time. There is, however, something more than knowledge of the shop operations and good judgment as to what sort of work is best for certain jobs needed to make a first-class foreman. A man is not fit for being a foreman unless he has some knowledge of theoretical mechanics, of mechanical calculations, and of drawing. The young machinist whose letter originated this article acknowledged that he knows nothing of drawing except that he can work to one, and he knows little or nothing of the mechanical calculations necessary in figuring the speed of tools and shafting, in estimating the power of screws or hydraulic pumps, in measuring by angles, or many other things that it is a foreman's duty to provide the data for. This man, who does not think his abilities are receiving proper recogtion, does not conceive it was necessary that he should acquire the knowledge of things that a lathe or vise hand is not called upon to perform. The man who takes no pains or devotes no labor to training himself on the higher and technical duties connected with his business is not justly entitled to rise above the grade of a workman. There are young men connected with nearly all shops who read and study the literature and technicalities of their business while others are devoting their leisure hours to amusement. The studious mechanic is the one who generally moves upward, and he has the acquirements that make him more useful as a foreman than other mechanics who may be more skillful in common shop work. Every improvement in machinery tends to call for increase of technical knowledge on the part of those who direct the repairs, and every year there is going to be less likelihood of a mechanic who is not familiar with the science of his business being selected as a foreman, no matter how skillful he may be in doing routine work. The young man selected for foreman is on the direct road to becoming the head of his department. To get on the plain road for making this distinction a mechanic must devote his leisure time outside the shop to the acquirement of the knowledge that is now necessary to fill the position with credit.

Auxiliaries of Successful Car Heating.

The approach of winter brings with it renewed interest in the safe heating of railroad passsenger cars, a subject which could hardly be called seasonable during the hot months of summer, when railroad managers, like other mortals, were struggling to keep themselves below the sunstroke temperature. Among some railroad managers, where an unyielding antipathy has been manifested to patronize anything safer than the common stove, the hope has been entertained that the sentiment which demanded safe methods of heating would have evaporated before this time; but it still appears to exist in all its pristine power, and the legislatures which have been approached during the summer, with the request that they put their seal of approval upon the stove, have displayed no disposition to do so. Public sentiment, which maintained three years ago that the deadly stove must go, still holds to the same opinion, and the most progressive railroad managers have gracefully accepted the inevitable, and are preparing to use steam or hot water. The progress toward making a change in the methods of car heating is moving forward as steadily and satisfactorily as any improvement on railroad appliances that has ever entailed important changes or involved serious expense.

It was not to be expected that the new systems of car heating would be perfect when first put into use, any more than other improved train appliances were when first put into service. Last winter the principal complaints made against steam heating systems were that the heat in the cars was too great, and that the temperature was not properly regulated. Had the winter been more severe, the likelihood is that the better perfected forms of safe car-heating would have advanced in popularity more than they did; but no method is likely to meet with popular approval unless it is looked after by the trainmen, and the appliances for regulating the temperature attended to intelligently. Merely contracting with car-heating companies to apply the apparatus and connections necessary to heat cars with steam or hot water is all that some railroad officers appear to think is necessary to successfully introduce safe methods of car heating. That is merely making a promising beginning. The next operation necessary to make any system a success is the training of the trainmen how to control its working. More than one steam-heated train went out last winter without a single man on board having any knowledge of how the temperature could be regulated, so it was not surprising that complaints were made that the passengers were either half roasted or frozen. The superintendent of a railroad who neglects to see that his trainmen understand how to operate train-heating apparatus and makes certain that they attend to it as well, is not fit for the position he holds. The general officers of many railroads have been for the last few years putting constant pressure upon the heads of the mechanical department to follow up enginemen and see that they are properly trained on all the duties pertaining to their calling. Engineers are not now considered of much account unless they are well versed in steam engineering and are familiar with all methods that can be resorted to for economizing fuel and heat. They must understand the working of all the apparatus connected with brakes and train signals, and they must be familiar with the mechanism as well as with the successful operating of injectors, lubricators, and various other locomotive appliances. The fireman who would make sure of promotion must know about as much as the engineer. The master mechanics have attended very conscientiously to encouraging the training of enginemen, and the companies concerned are reaping the benefit in their service being better and more economically performed. What has been forced upon enginemen with

benefit to employés and employer might, we think, now be extended with advantage to the other trainmen. The introduction of continuous brakes took away from conductor and brakeman all responsibility in controlling the speed of trains, and left them with very little work to do. It is only right that now they should be instructed in the care of all car mechanism, and be required to attend to it, especially on the parts that regulate heating and ventilation. If trainmen were properly trained in the managing of the car-heating apparatus, and were required to maintain the temperature of the cars as nearly uniform as possible, it would add very materially to the comfort of passengers. There is no fear but the men will soon acquire all the knowledge necessary if they are only given the opportunity, and are informed that they will be held responsible for regulating the temperature. If during the coming winter passengers have reason to complain of suffering from cold or heat due to the ignorant handling of safe heating apparatus, while the trainmen stand round imbecile to give help beyond opening or closing the ventilators, the blame for the discomfort of travelers is more likely to rest with the officers who neglect to have their trainmen instructed than with the appliances for transmitting the heat.

Incivility to Passengers.

An enterprising reporter of a daily paper managed during the summer to fill up the hiatus of copy liable to happen during the dog days by interviewing trainmen and obtaining from them descriptions of how their duties were performed. There was nothing very striking or amusing told, but one interview is worthy of some notice, because it professed to describe the antagonism with which a passenger conductor regarded the public, particularly that portion of it which travels in emigrant cars and is given to asking for information. The conductor prided himself on being particularly smart, and his method of working the train was to profess ignorance of or inability to answer any question that would delay his progress an instant. The picture was so true to nature, as we have repeatedly seen it manifested in our travels, that we feel moved to contemplate it a little from a standpoint different from the Smart Aleck conductor. Train men as a rule are civil and obliging, but there are a great many exceptions, and on some roads the exceptions are so numerous that they appear to form the rule Where this is the case the train men are merely reflections of unworthy men above them. Where the head of a department is a ruffian it cannot be expected that the subordinates will be noted for gentlemanly behavior. Men who are permitted to treat with habitual discourtesy the humbler portion of the traveling public, not only inflict injury on the company they work for, but they sow seeds of hatred that brings antagonism to all railroad interests. Anti-railroad sentiment has been industriously cultivated in many districts by the habitual incivility and want of accommodating sentiment among railroad officials, and rudeness on the part of trainmen sows broadcast the seed that produces a similar harvest. The emigrants and the second-class passengers, who are often treated by trainmen and by some railroad officers as if they had no rights that demanded respect or feeling that deserved humane treatment, may not be able to influence legislation much, but they are likely at any time to have potent power on juries. The law of self-preservation alone, if no higher consideration can reach them, ought to convince railroad managers that civility is a good paying investment.

Where incivility is rampant on any railroad the cure lies with the owners of the property, and they deserve no sympathy if their revenues suffer through bad management. But it occasionally happens that men of most obnoxious demeanor are able to elude the vigilance of worthy superintendents, sycophancy to superiors being a common accompaniment of habitual incivility toward those who apparently have no influence at headquarters. Where this is the case it is the duty of travelers to report cases of incivility, not only to themselves, but to others, when anything of the kind comes under their notice. Travelers are often tiresome and annoying in the persistent way they have of asking questions, but the conductor and other trainmen are the only persons in authority to whom strangers can appeal for information about their journey, and the man who cannot listen to reiterated questions without displaying irritation and expressing the same, is not fit for a position on a passenger train. On some roads the superintendents regard their rule, that calls for the promotion of freight conductors to passenger trains by rotation, as being as inflexible as the laws of the Medes and Persians, but it would often be better for the men, for the companies and for the traveling public if fitness received a little more consideration and seniority a little less homage.

Look After Stay-Bolts.

In our visits to the machine shops of the various railroads throughout the country, we find that there is a growing inclination among master mechanics to make sure that stay-bolts are intact, by drilling small holes in far enough on the outside of the bolt to give unmistakable evidence when breakage takes place. The general tendency is toward higher boiler pressures, and on not a few boilers the pressure has been increased without anything being done to increase the resisting strength, a plan that is very much like that pursued with many cars where the carrying capacity is increased by merely using a new stencil. Most boilers when in good order will stand the pressure of 150 or 160 pounds per square inch with safety ; but there is a dangerously small margin left for deterioration. As the breaking of stay-bolts is the most common form of deterioration, and the defect most likely to lead to disaster, it behooves all those responsible for the safety of boilers to do all in their power to promptly detect this source of growing weakness; and we know of no better precaution than that of drilling the stay-bolts through the outside sheet. The plan is simple and effective, and can be carried out at small cost, now that most shops are furnished with flexible shafting or other means of transmitting power to drills that can be operated on engines in the stalls.

Nearly all railroad companies are very careful in the inspecting of fire-boxes for broken stay-bolts, and yet it is surprising how many of these are found broken in nearly all engines that go in for general repairs after long service. The changes of temperature keep the inside shell of the fire-box constantly changing its length, and this keeps moving the stay-bolt till fracture takes place, in the same way that a wire is broken by repeated bending. The breakage nearly always takes place close to the outside shell, where the strains of movement appear to concentrate, and the stay-bolt being drilled through that point reveals the fact when fracture happens. If the hole made is small, there will be no inconvenience experienced in getting the engine home after a stay-bolt breaks, so there is really no reason why this simple practice of providing for the detection of broken stay-bolts should not be universally adopted. We have heard of a master mechanic who objected to drilling holes in stay-bolts on the grounds that leakage was a nuisance when a stay-bolt broke, but happily there are not many of that class of officials who have such contracted mental vision indicated by the expression of such a sentiment. The reluctance to adopt the drilling safety plan is generally explained by the assertion that the inspectors get on to all broken stay-bolts, and that "we have never had a boiler explosion." The numerous stay-bolts that are found when engines go into the back shop for general repairs seems to prove that the average inspector cannot be implicitly relied upon, and neglecting precautions that are acknowledged to be efficient is inviting the explosion that is liable to happen too soon. The locomotive fire-box is at the best a difficult form in which to resist the conflicting strains to which it is constantly subjected, and no pains or trouble ought to be spared to make it as safe as circumstances will permit.

Quackery Against Trained Skill.

Mr. Henry R. Towne, the well known mechanical engineer, is a member of a committee appointed by the Mayor of New York City to make arrangements for holding a great exhibition in 1892 to commemorate the discovery of America. At one meeting of a committee held to consider the best site for holding the exhibition, Mr. Towne suggested that topographical engineers be employed to examine the grounds proposed as sites, and the rest of the committee very emphatically rejected the proposal. Most of the members considered themselves as individually competent by their common sense to decide on the merits of a site as a trained engineer could be. The egotistical spirit displayed in this matter may prove very prejudicial to the success of the exhibition, should the decision be made to hold it in New York. It is the spirit which has marred many a promising enterprise, and makes American business men and capitalists celebrated as dupes for all kinds of swindlers, quacks and charlatans. In other countries, when a capitalist is asked to advance money on any enterprise or interest himself financially in any invention he employs experts to investigate the merits of the thing, but here they generally rely on their common sense, with the result that any persuasive talker can get almost unlimited financial backing to any fraudulent scheme or sham invention. Keeley motors, Triple thermic motors, Fontaine locomotives, Swinnerton locomotives, and all sorts of frauds and shams that any respectable engineer would readily estimate at what they were worth, receive no end of support because the people who waste their money upon them prefer to follow their own in preference to the judgment of a man trained to comprehend mechanical appliances. The public probably has no right to interfere with a man in wasting his own substance in the support of cranks and frauds, but a committee appointed to perform public duties ought to be restrained from unwisely spending money contributed by others. If the committee on the New York Exhibition display the same disposition to dispense with the services of experts in other departments of the work to be done that they exhibited in regard to the selection of a site, they will prove a very expensive and very incompetent board of management.

A meeting of the Order of Railway Conductors, attended by about 300 delegates, was held at Kansas City, Mo., Sept. 2. A dispatch says that the object of the meeting was to devise some means whereby the dissolution of the order, threatened by the inroads made upon it by the new Brotherhood of Railway Conductors, may be averted.

Favors Encouraging Inventors.

The remarks which we made in last month's issue of the National Car and Locomotive Builder on the need of an improved oil-box for freight cars have brought out two communications, which appear in another part of this paper. An "Old Car Builder," a highly respected railroad officer, whose views we hold in the most profound respect, takes a conservative view of the subject, and inclines to resent any action calculated to endanger the maintenance of existing standards. We are uncompromising supporters of standards, and we have repeatedly insisted that it was better to have an inferior standard that was generally used, than a perfect form which very few of the roads interested would consent to adopt. On the other hand, we think that the fact of a standard having been once adopted ought not to stand as a barrier against all future improvement, and we are in harmony with a great many master car-builders in thinking that the standard oil-box has outlived its period of usefulness and true utility. We gracefully bow to the rule of the Master Car Builders' Association that prevents patented devices from being adopted as standards, but we would like to see the inventive genius of the country that seeks not patent protection to try its hand on the designing of an axle box that would keep oil in and dust out. This act of self-denial might be witnessed if the Master Car Builders' Association would display a disposition to adopt an improved box.

Another correspondent, A. M. L., out-herods Herod, for he not only wishes to see the standard axle-box changed, but he assails the time-honored diamond truck, and wants it consigned to the limbo from whence there is no exit. We are very little in sympathy with this correspondent. The shortcomings of the diamond truck are of a kind that is much easier criticised than remedied. We would certainly like to see a better truck produced, and we are not without hopes that it will be done, but we are by no means sanguine about it. We shall, however, be glad to lend the use of our columns to the showing up of a better truck than that now generally used, when anything of the kind shall be designed. As there is no standard truck the field is perfectly open for the labors of inventors.

New Publications.

A History of the Planing Mill: with Practical Suggestions for the Construction, Care and Management of Wood-working Machinery. By C. R. Tompkins, M. E. John Wiley & Sons, New York.

This is a very interesting book on a subject that has been very little written upon by practical men. The author is evidently very familiar not only with the history of the planing mill, but with every detail connected with its construction and successful operation, and he tells what he knows in an easy-going attractive, fashion. Tools for working wood were no doubt among the first inventions of primitive man, but the application of power to wood-working tools is almost within the memory of the oldest inhabitant. This book gives a highly readable account of the history and development of the wood-working machinery which fill the planing mill. The first eight chapters are almost entirely confined to this part of the subject. The remainder of the book is devoted to the construction, care and management of planing-mill machinery. The book ought to be in the hands of every master car-builder and foreman having charge of wood-working machinery, and we very cordially recommend it to their notice. It is sold for $1.50, a very modest price considering the merits of the work.

Master Mechanics' Report.

The Report of the Proceedings of the Twenty-second Convention of the American Railway Master Mechanics' Association has been delivered to the members and others. The report is of the usual form, and is about the same size that it has been for two or three years. Circumstances have made it necessary for us to read the Master Mechanics' reports very carefully of late years, and we are well able to judge of the relative merits of the proceedings of different conventions, and we believe that the committees' reports of the volume now before us are the best that were ever submitted to the Association. It would be invidious to pick out one for special mention. We feel sure that persons interested in railroad mechanics will find very valuable matter and interesting reading in the twenty-second annual report. There are reports on Tires, Driving and Engine Truck Boxes, Boiler Covering, Driver Brakes, Best Proportion of Grate and Flue Area, Foundation Ring for Boiler leg, Water Space surrounding Fire-box and Flues; Magnetic Influences of Iron and Steel on Watches, and obituary notices of William H. Morrow, George C. Watrous, and S. W. Haines. Discussions followed the reading of most of the reports, and very interesting discussions most of them were. There were also very interesting discussions on a variety of topical subjects introduced at noon each day. These topical discussions have become an interesting feature of the convention, and the notes of experience brought out increase the interest of the annual report. A very full index of the report has been prepared, which enables one to readily find anything that is in the volume. The speeches have been considerably condensed through the editorial labors of Secretary Sinclair, but nothing that was said has been left out.

Personal.

Mr. Robert Bell, division superintendent of the Western New York & Pennsylvania road, has been appointed general superintendent, vice Mr. G. S. Gatchell, resigned.

Richard Vose, the car spring manufacturer, has moved his New York office from 13 Barclay street to 52 Boreel building. The National Car Spring Company also has its office at this location.

Mr. E. J. Remillion, superintendent of the Kansas City Switch and Frog Works, died Aug. 10 in that city. He was well known among railroad men as the inventor of a patent three-throw switch.

Mr. W. W. Hegemann, who has for some years been connected with the Baldwin Locomotive Works, has been appointed to succeed Col. James Montgomery as superintendent of the Ohio Valley Railroad.

Mr. M. W. Elliott, who has been for some time master mechanic in charge of the Texas & Pacific shops at Marshall, Texas, has been appointed acting superintendent of motive power, in place of Mr. H. N. Burford, deceased.

Mr. John S. Silver has been elected president of the Eutawville Railroad Company, of South Carolina, in place of Mr. R. C. Berkley, resigned. Mr. Silver still retains his interest in the National Car Spring Company, of New York.

Mr. A. J. Pitkin, superintendent of the Schenectady Locomotive Works, has gone to Europe on a visit. He and Mr. Angus Sinclair have gone on the same boat, and they are under a mutual compact to do basin service for each other.

Mr. R. L. Ettenger, who has lately been appointed superintendent of motive power of the American Midland, is a graduate of the Chesapeake & Ohio, and is a very bright young mechanical engineer. He is a brother of Mr. G. W. Ettenger, of the New York Iron Car Company.

A. M. Waitt has resigned from the Pullman Palace Car Company, to take effect Oct. 1, at which time he will assume the duties of Assistant General Master Car Builder of the Lake Shore & Michigan Southern, with headquarters at Cleveland.

Mr. Frank C. Smith has been appointed master mechanic of the Cincinnati, New Orleans & Texas, at Chattanooga, with charge of the shops at that place. Mr. Smith was, for several years, general foreman of the Ludlow shops, under Mr. James Meehan, superintendent of motive power of this road.

Mr. H. N. Burford, Superintendent Motive Power of the Texas & Pacific Railway, died at Marshall, Tex., Sept. 6, after an illness of eight months. He had been with the Texas & Pacific since June, 1888, and was formerly for sixteen years connected with the Memphis & Charleston road. Mr. Burford was one of the most popular members of the Railway Master Mechanics' Association.

The Baldwin Locomotive Works are said to have offered to construct for the Baltimore & Ohio Railroad Company a locomotive of the compound pattern, similar in principle to the English locomotive built for the Pennsylvania Railroad Company. The English engine was not a success, it is said, because American grade climbing was not considered. It is stated that the Baltimore & Ohio will probably accept the Baldwin Company's offer and give the engine a test.

Mr. A. L. Mohler, who has just been appointed general manager of the St. Paul, Minneapolis & Manitoba, first reached to prominence on the Burlington, Cedar Rapids & Northern, where he rose from clerk in the auditor's office to general freight agent. He is a very pleasant, genial gentleman, but the secret of his success appeared to be that he devoted himself very earnestly to the business assigned him to do. He has glided quickly upward by making his business his most important business.

Owing to a disagreement with the higher officers respecting the details of management, Mr. E. T. Jeffery, general manager of the Illinois Central Railroad, resigned his office suddenly on Sept. 3. Mr. Jeffery began railroad work on the Illinois Central as an office-boy, and rose through the grades of apprentice, machinist, draughtsman, assistant superintendent of machinery and general superintendent to the position of general manager. While being a decidedly conservative man, Mr. Jeffery had the reputation of being an excellent railroad officer.

The New South Wales *Railway and Tramway Review* had lately a fine page supplement printed to give full particulars of a complimentary banquet and presentation in honor of Mr. Thomas Midelton, lately locomotive superintendent of the railways of the colony. Through a political change a party came into power that was opposed to the policy of the interests that appointed Mr. Midelton, and he was removed from a position that he had filled for several years with great credit to himself as an executive mechanical officer and with great profit to the colony. The banquet and presentation of an illuminated address and service of silver plate were gotten up by the employés of the railway where Mr. Midelton had charge, and bore eloquent testimony to the popularity of their retiring chief.

The writer passed through one of the Chesapeake & Ohio's magnificently equipped handsome vestibule trains down in Kentucky a few evenings since. Five of the rear cars of the train were finished in mahogany, walnut, oak, cherry and birch, respectively, in the highest style of modern art in wood finish. It is needless to say that the mahogany, walnut and cherry presented a rich and pleasing attractiveness, but the oak and birch were a surprise and cause for admiration from all beholders. They are light and cheerful and rich in effective beauty, not surpassed by the more expensive woods. That both will be more largely used in the future for such purposes and interior decoration generally goes without saying.

In another column will be found a communication from J. E., a car inspector at an important point of interchange, raising for discussion some very difficult questions relating to the interchange of cars. The Master Car Builders' Association have labored very persistently in trying to formulate fair and just rules to be observed in the interchange of cars, but the disputes between railroad companies about the condition and the right to repair cars appear to be increasing instead of diminishing. Anything that will facilitate the interchange of cars and reduce the number of disputes that arise connected with the business would be of benefit to railroad companies, and we would like very much to see the questions submitted taken up and thoroughly discussed by our readers.

The Schenectady Locomotive Works are preparing to begin the construction of a mogul compound locomotive. The engine will be of about the same power as ordinary moguls of the same weight, and will have two cylinders arranged in the same way, except that one will be large enough to perform the duties of a low-pressure cylinder. Mr. A. J. Pitkin, superintendent of the Schenectady Locomotive Works, has designed this engine, and some inventions that he has got out for regulating the admission of steam to the cylinders have been covered by letters patent. Steam will be admitted to the low-pressure cylinder direct in starting, but reduced in pressure so that the power transmitted on that side will never be greater than that transmitted by the small high-pressure cylinder. The mechanism of the compound locomotive will not be any more complex than that of a simple engine, and it will be as easily operated. The intention is to subject this engine to searching tests working against a common engine of the same capacity. The builders are determined to know exactly what there is in the compound locomotive.

There is reported to have been some friction between the supply interests and the members at a convention of the Roadmasters' Association held at Denver last month. Commenting on it, the *Railroad Gazette* says: "The conventions of the Roadmasters, the Master Car-Builders and the Master Mechanics are accepting too much from the supply men in the way of entertainment, and if measures are not taken to restrict the importance and the prominence of this side of the conventions misunderstandings like that at Denver are sure to arise." We are not familiar with the merits of the dispute referred to, and we do not know how business at the Roadmasters' conventions is conducted; but we think our contemporary has used the incident to read a lecture to the Master Car-Builders' and Master Mechanics' associations that was entirely uncalled for. The tendency for years at the annual conventions has been to restrict the accepting of favors from supply men, and none are now taken, as far as we can see, that either association has the right to interfere with. It is a gross injustice to the associations to imply that the members permit the supply interests to interfere with their business, as a return for obligations received in the shape of entertainment.

Mr. F. W. Dean, of Cambridgeport, Mass., who has been one of the most valuable associate members of the Railway Master Mechanics' Association, has made boiler designing a special study, and any information he gives on this subject is deserving of careful attention. The working steam pressures are increasing so rapidly that the master mechanics in charge of highly pressed boilers cannot examine too carefully into points of weakness that may bring disaster. The report of the committee on Foundation Rings, which was submitted at last convention, recommended that double riveting be used for mud rings, but the advice seemed to be little heeded. Mr. Dean gives a forcible reason for double riveting, which was not brought out by the committee referred to. He says: No person can by any possible means compute the stresses in a crown bar stayed, or a direct stayed system of supporting the crown sheet, and therefore nobody knows whether his boiler is safe or not. If the crown bars are not "slung up" to the shell the stresses in them can be computed, but then the steam pressure on the crown sheet is tending to push the inside firebox out of the boiler, and thus place the stay bolts in transverse stress (which must be a cause of stay-bolt failure), and finally tending to rotate the base ring. The latter should in this case, if for no other, be double-riveted.

How to Test Cast-Iron.

We have received from Mr. J. B. Johnson, professor of civil engineering and director of the testing laboratory, Washington University, St. Louis, a long article on "how to test cast-iron," and describing a simple form of machine designed for testing cast-iron. We regret that we have not the space to spare for the entire article and for illustrating the machine. The article concludes:

The price of this machine is so low, and its adaptation to the work so simple and perfect that it is hoped it will be generally introduced, and that the new rule given above for showing the resilience or shock-power of the iron will be universally adopted.

The writer has recently contributed to the American Society of Civil Engineers a paper on Tests of and Specifications for Cast-Iron, a copy of which will be furnished on application as soon as it appears. He hopes to help bring about a reformation in the scientific study of this material of almost universal use, but which has been largely overlooked by our scientific investigators in their zealous and astonishingly profitable labors on wrought-iron and steel.

Any further information concerning the new testing apparatus, or the methods of using the same, or the limits of strength and resilience to use in specifications for cast-iron will be cheerfully furnished by addressing the writer at the address given at the head of this article.

Consolidated Car Heating Company.

The Consolidated Car Heating Company makes the announcement that it has acquired all the rights, patents, devices and other property of the Sewall Safety Car Heating Company and the McElroy Car Heating Company, together with other valuable rights and privileges, embracing over 100 patents for car heating appliances, and all that is best known and most thoroughly approved by the test of practical experience, in complete and perfected systems of car heating.

These include heating by Direct Steam, Hot Water Circulation, Storage Systems, and a new and improved Return System.

The company is therefore prepared to offer to railway companies the choice of the best of the various methods of heating cars without fire, or a combination of any or more of the several systems which it controls. This must be a great convenience to railway officials, and do away with much of the embarrassment and hesitation heretofore experienced by them in choosing between a variety of systems, each possessing some apparently preferable features, which have been pressed upon their attention. Any railway manager can now, if desired, combine the features that seem to him preferable in several different systems through this company, without the trouble and confusion which would be involved in attempting to do this by dealing with two or more different concerns.

The organization of the Consolidated Car Heating Company is a very strong one in all requisite features.

It has a capital of $2,500,000, and among its directors and officers are some of the best known business men and substantial capitalists of Albany, Portland and other points which have heretofore been known as important centers of car heating interests. Its executive officers are Robert C. Pruyn (of the National Commercial Bank, Albany), president; A. S. Hatch, of New York, vice-president; Col. Wm. G. Rice, of Albany, vice-president and treasurer, and Charles J. Peabody, of Albany (of the firm of Spencer, Trask & Co.), secretary. Its inventive, mechanical and sales departments are in the hands of the most experienced and best known experts in the car heating business, including D. D. Sewall, as general manager; J. F. McElroy as mechanical superintendent, J. H. Sewall as assistant general manager, and a corps of tried and experienced travelers, mechanical experts and superintendents of construction and car equipment.

The company has established shops and depots of materials and appliances at Albany and Chicago, where they will carry in stock everything necessary to enable them to fill orders promptly on short notice; and they are prepared to furnish at any desired point competent and experienced men to oversee the skillful execution of orders and to give intelligent instruction to railway employés in the effective and economical management of car heating apparatus.

Gentlemen thoroughly familiar with the subject will call upon railway officers or managers at their request at any time, for the purpose of explaining the different systems and devices employed by this company, and will show tracings, blue prints, or models for their inspection when desired.

The principle offices are at Albany, N. Y., with branches in New York City, Chicago, Ill., and Coaticoke, Province of Quebec, Canada.

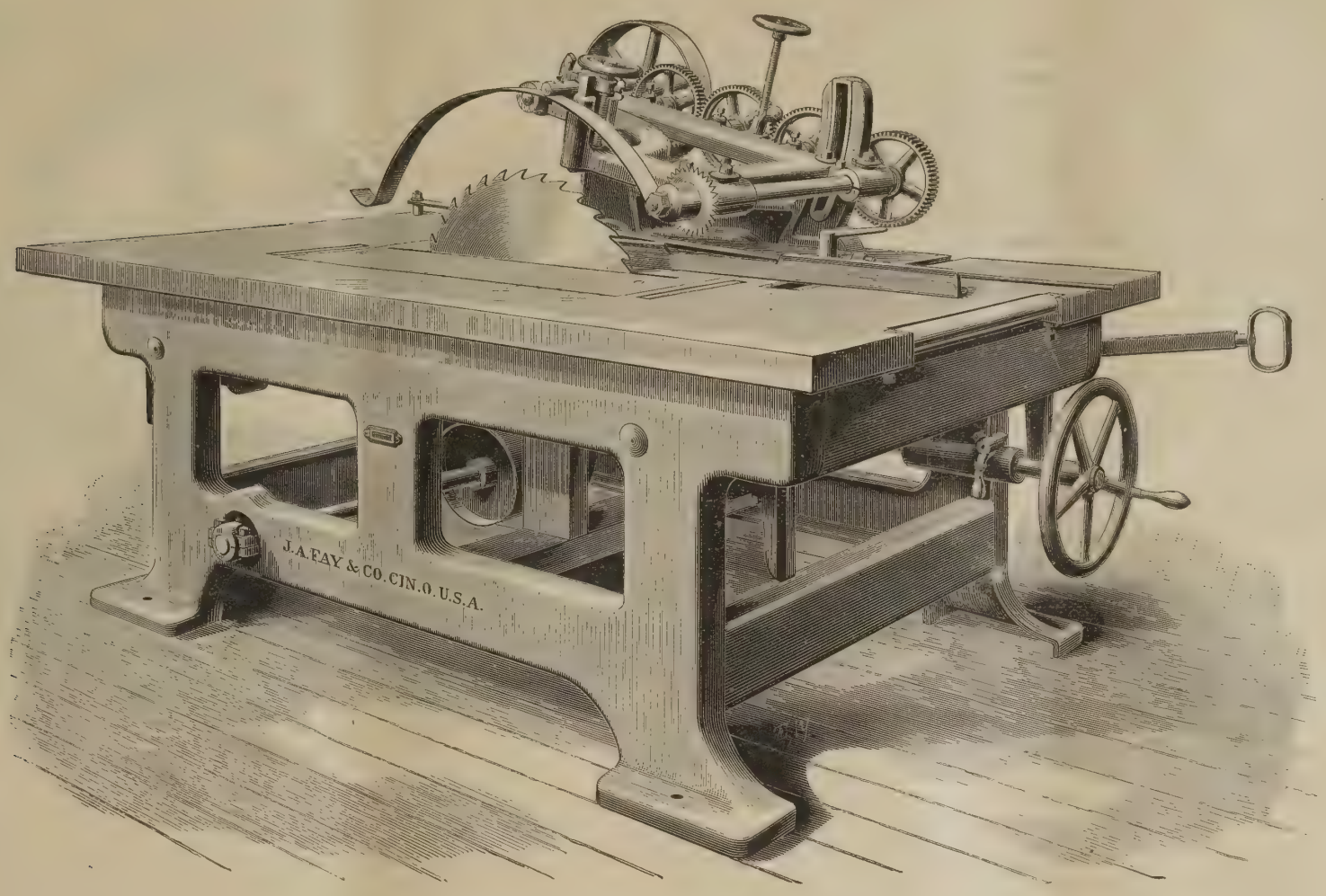
The Pond Machine Company, New York, have lately received orders from the Cleveland, Columbus, Cincinnati & Indianapolis for several heavy tools for their shops at Braidwood, Ind., among them being a large driving-wheel lathe.

We have received from the Niles Tool Works, Hamilton, O., a very handsomely illustrated catalogue of the planers made by the firm. The style of the catalogue is almost worthy of the design, workmanship and finish of the machines they illustrate.

Mr. G. W. Ettenger, general manager of the Iron Car Company, New York, makes the following announcement: Mr. J. T. Martin, late with the Chesapeake & Ohio Railway, has been appointed supervisor of equipment for this company. He will have general care of the rolling stock of the company, both under construction and in operation, reporting directly to this office. Appointment to take effect this date.

Mr. Stewart Hartshorn, on his return from a visit to the Paris Exhibition, expressed satisfaction with the perfected improvements in buildings and machinery at his factory in East Newark, ordered before leaving for France. He reports that his Parisian exhibit is attracting very satisfactory notice. It will be remembered that the Hartshorn roller got the highest award at the World's Fair held in Paris during 1878.

Last month Mr. J. A. Crawford, of Quincy, Ill., while drinking a glass of water, had the misfortune to swallow his false teeth. Death resulted almost immediately. Just previous to the occurrence he drew an accident ticket issued by the Employers' Liability Assurance Corporation, Limited, of London, from one of the automatic ticket boxes now so commonly seen in railway stations and elsewhere all over the country. The company promptly paid the $500 insured by the ticket. This is a pretty good return for five cents.



SELF-FEEDING RIPPING SAW TABLE.

The accompanying engraving is one of the largest and most durable ripping saw tables with self-feed, made by J. A. Fay & Co., Cincinnati, O., and a machine of great importance to the manufacturer of cars, locomotives, agricultural implements, wagons, and wherever the ripping of heavy timber is necessary. It does the work with a rapid and positive motion that will increase the product of any factory very materially over the old methods.

The feed consists of a combination of gearing and belts operating a toothed feeding disk acting on the top surface of the lumber in the same line the saw cuts. It is under perfect control by the hand lever, and can be started or stopped instantly.

The feeding disk can be retained at any desired height from the table by means of a hand wheel and screw, and the entire feeding mechanism may be elevated and thrown back out of the way or sustained by a supporting rod, if it is desired to do ordinary ripping.

The mandrel is of steel, large in diameter, and arranged so that several saws may be used at a time, and by using several feeding disks on the feed shaft, will bring the machines to their fullest capacity. A long outside bearing supports the pulley Each machine is provided with an improved adjustable fence, that can be instantly fixed at any point. There is also a hold-down which prevents the material from being carried back by the saw, and which acts as a guard, being attached to and moving with the feeding frame.

The table is of good length, made of iron, and has a hand wheel and a raising screw at the front end for raising it parallel. A friction roll is placed in the table, just below the feeding disk, to relieve the material from friction.

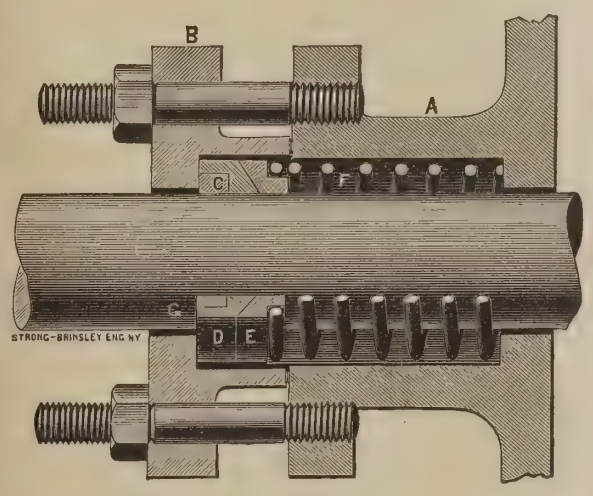
The saw arbor pulley is 12 by 8 inches, and should make 1,800 revolutions.

When desired, a countershaft is furnished with the machine at a small extra cost. The tight and loose pulleys are 12 by 8 inches, and should make 845 revolutions.

The Energy Manufacturing Company, Philadelphia, have issued a new illustrated catalogue, containing the latest of their appliances for hoisting and other purposes. The list comprises a friction-driven center grinder, adjustable clamping blocks, drill guide and steady rest, and a great variety of hoisting apparatus. Those who use any of these things ought to send for the catalogue, where they are sure to find information that will interest them.

The Pond Machine Tool Company, New York, has received an order from the New York & New Haven Railroad for a steel tire turning lathe, for turning steel wheels on the axles; this machine weighs about 23 tons and permits the use of a broad-faced tool, taking the entire tread of both wheels at one cut. Several of these lathes are already in use on different roads. The company is also building for the same road a 79-inch driving-wheel lathe with double quartering attachment.

The National Hollow Brake Beam Company have increased their capital stock and elected new officers. H. D. Loughlin, President; E. B. Leigh, Vice-President and Treasurer; A. Crandall, Secretary; L. C. Burgess, Superintendent. Mr. Arthur Crandall was formerly connected with the Dunham Manufacturing Company, and his many friends will be glad to know he has bought an interest in this company. The company is now erecting large shops in Chicago for manufacturing the brake beams. During the first ten days in September the company received orders for upward of 6,000 brake beams.



The annexed engraving illustrates the Excelsior Anti-Friction Metallic Packing, manufactured by Watson & Stillman, New York. The high efficiency of the metallic packing and its great superiority over all forms of fibrous or soft packing for piston rods, valve stems, throttles, or pump rods, are now so fully established and acknowledged by all practical engineers that it is not necessary here to more than state what is claimed for this metallic packing, which is shown in the cuts as applied on locomotives.

The two rings *C* and *D* are the anti-friction rings, which fit tight against the face of the case *B*, and also between themselves, as shown.

The ring *E* and spring *F* serve to hold them in place when rod is on back stroke.

A patent concave copper packing ring is clamped between the faces of *A* and *B*.

The claims made for this packing are:

First.—It has less parts than any other metallic packing.

Second.—It is more economical to use than any other style of packing, metallic or fibrous.

Third.—It is the only packing which employs the steam pressure to make it tight on the rods, the rings closing up as they wear.

Fourth.—It is the only one which relaxes the pressure on the rod when the engine is shut off and running on a down grade.

Fifth.—It is the only one in which the split rings are prevented by the construction from working into a position with the openings in line, and thus allowing steam to blow through. [This specially patented feature is not easily shown in the cuts.]

Sixth.—It is the only one which is not surrounded by a retaining or compressing cone to tighten it on the rod, and which keeps it there when steam is shut off and rod is running dry.

Seventh.—In this there is no cast-iron packing case to break or extra delusive ground-joints to adjust or keep tight.

Eighth.—It is the only one having a cellar in the valve-stem case of horizontal rods, which allows the packing to settle with the rod and so prevent touching and causing leakage without being too large in diameter.

Ninth.—This packing, when applied to a rod which is parallel, will keep it true.

Tenth.—It is cheaper than any other reliable metallic packing.

Eleventh.—Any one can apply it.

We have received from the Jos. Dixon Crucible Company Jersey City, a pamphlet containing testimonials respecting the merits of their silicon-graphite smoke stack and boiler front paint. The testimonials are very strongly in favor of this paint, and have been given by highly respectable firms, whose evidence is all that could be desired.

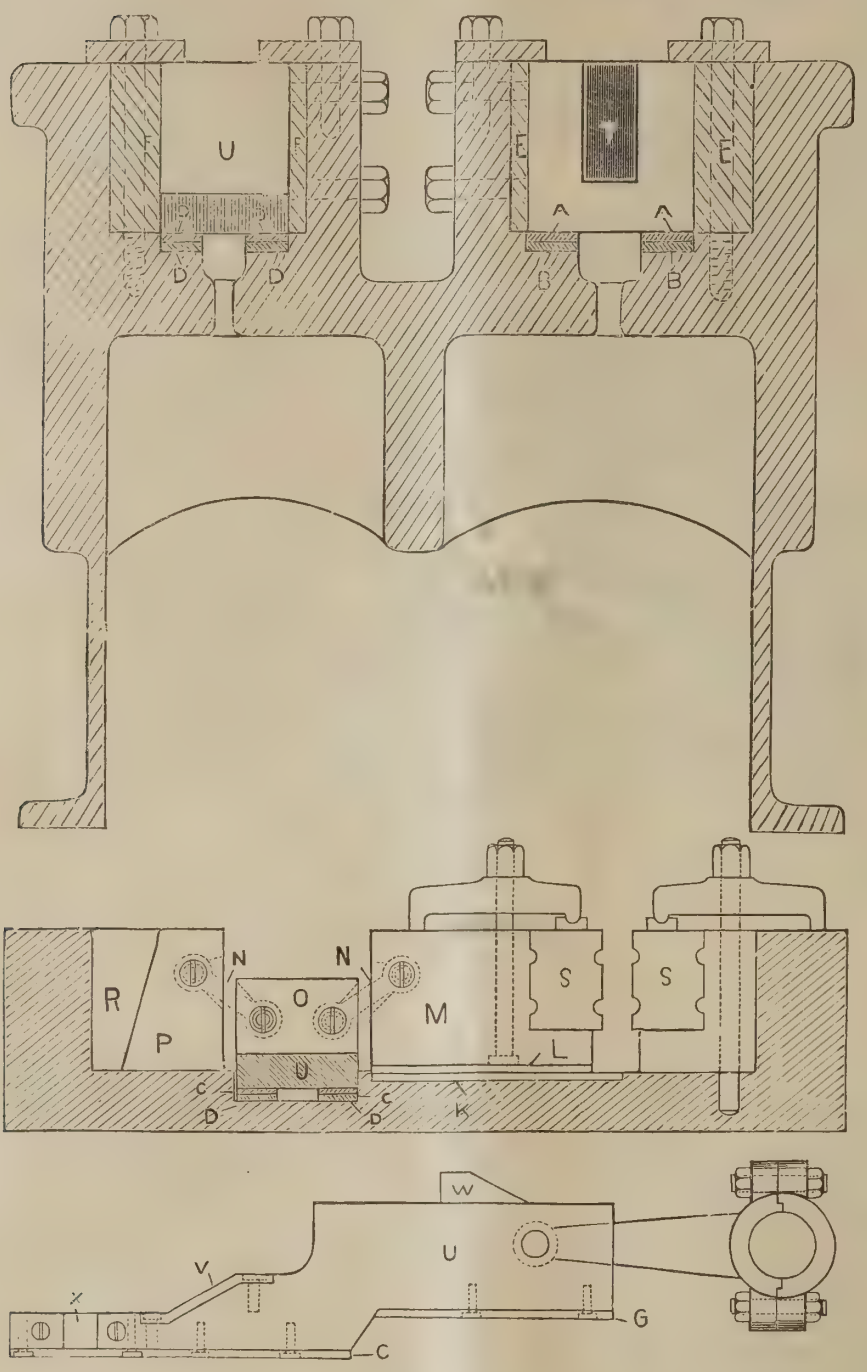
The Butler Drawbar Attachment Company, Chicago, are meeting with unusual success in the introduction of their device. Some roads have adopted it as their standard, and others are having it applied on all their new equipment. Those who have had it in use for some time are unanimous in its praise; they say it is the most economical device for the purpose yet introduced, that it more than meets their expectation in the way of efficiency, and they feel justified in recommending it to parties who are looking for the best.

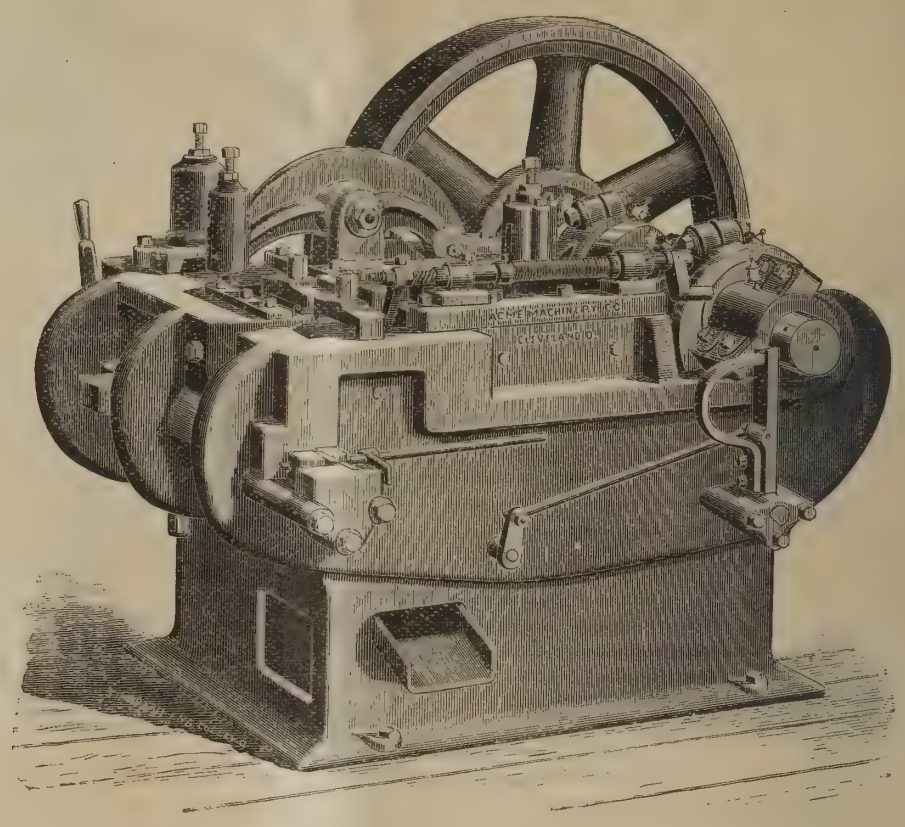
We, Messrs. Pedick & Ayer, Philadelphia, were crowded out. That expresses it exactly. We were either obliged to limit the volume of our business or secure quarters where we could handle it advantageously. We naturally chose the latter and we are now moved and settled in our new shop at 1,001 and 1,003 Hamilton street and 1,002 and 1,004 Buttonwood street, about half a block below our old quarters. We now have ample facilities for turning out all orders entrusted to us promptly and in a manner calculated to maintain the reputation we have as builders of high-grade machinery and tools. We cordially invite you to call and inspect our new shop.

In the extension of the Diamond Machine Works on Aborn street, Providence, R. I., there is to be seen a line of shafting which in hangers, couplings and shafts approaches the ideal of perfection. The hangers are graceful in their lines—oval shaped and hollow, combining strength with stiffness. The bearings are of the type known as ball and socket and self-oiling. The coupling is very novel in its construction, easily removed and replaced, while its grip upon the shaft is so powerful (effected by four taper screws operating on internal clamps) that in repeated trials shafts have been twisted off by torsional strain even when the couplings were used without keys. This shafting is from the Cresson Shafting Works, Philadelphia. They have had the honor of always supplying and meeting the exacting requirements of the Brown & Sharpe Co., for their original works and recent extensions.

The ordinary method of joining the ends of leather belts in factories and workshops is very generally known to be a tedious and expensive one—tedious because the lace joint has to be made correctly to be strong, smooth and durable; and expensive, because the operation takes a workman's time which might be more profitably employed, and the machinery the belt drives is necessarily at a stand still until the belt is mended. There have been not a few devices invented with the object of overcoming, or at least, reducing these annoyances, but we do not remember seeing any device that answers the purpose so admirably as the one devised by Prof. W. H. Bristol, of the Stevens Institute of Technology, Hoboken. It consists of a zigzag band of perforated steel, with spurs on each side that go down through the ends of the belt and are riveted on the opposite side. This fastening makes a smooth and elastic joint. In applying it the spurs are first driven through the belt ends upon a piece of soft wood; then, laying the smooth side of the joint upon the pulley or any convenient piece of iron, the points are clinched. No special tools are required.

ACME MACHINERY COMPANY STANDARD HEADER.





A new machine brought out by the Acme Machinery Company, Cleveland, O., entirely novel in design, and embodying the best movements and construction which have been used and found valuable in the factory practice of several superintendents covering a period of over twenty-five years.

Great care has been taken to overcome the destructive shocks given the die-closing mechanism by the old practice of using cams, and the equally injurious torsional strains to which some new machines are subject where side shafts are used to operate the toggle movement. The bed is made in the box form, with three deep trusses runnning through its entire length, the box-leg being a continuation of outside trusses. This form gives enormous strength, and avoids any chance of the bed breaking under the bearings or split through the center of the machine, as is the case with many machines.

The eccentric shaft (which is of the best forged iron) is carried in three bearings 8 inches long and 5½ inches diameter. The face of the bearings being inclined toward the front of the machine at an angle of 60 degrees brings the thrust of the forging tools and die-closing mechanism against solid metal and relieves the main cape and cap-bolts from all strain.

The heading slide *T* is unusually long and is 8 inches deep, supported on hardened and ground tool steel ways *A A* 30 inches long and 2¼ inches wide, which rests on similar strips *B B* attached to the bed of the machine: cast-iron gibs *E E* being used on each side of the slide, insuring perfect alignment during years of service with the added certainty that should the steel ways ever become worn, they could be trued up in two hours time without the trouble and expense of dismounting and removing the entire machine to the machine shop.

The dies are closed by the toggle joint movement, the center toggle block *O* being actuated by an inclined plane *V*, or wedge, of easy incline, resting upon a reciprocating slide, *U*, driven by an eccentric and connection from the main shaft.

This slide has the same style of steel ways, *C C*, *D D*, *G G* and gibs *F F*, as are used on the heading slide. The center toggle block *O* and movable die block *M* are returned to their normal position by a rocker arm, provided with a roll on its rear end, engaging with a return incline, *W*, on the upper and rear end of toggle slide.

The toggle arms, *N N*, are of tool steel, 2½ inches in diameter on their ball ends, and 6 inches long, working in a radius of only 2¾ inches. The ends of both arms are let into solid steel blocks, and besides having wearing surface of over two-thirds their diameter, and are further supported by steel pins passing through their center and held in place by front and back plates. The movable die block is provided with and rests on steel ways, *K K* and *L L*, in the same manner as the main slides.

No moving parts of the machine work upon the bed except the eccentric driving shaft—a method original with the Acme Machinery Co., and one that saves the expense of frequent removals to the machine shop.

The dies and punches are of novel construction and designed to turn out perfect work with few blows, avoiding the constant and expensive repairs necessary to the slides and connections of hammer machines.

Track bolts, plow bolts, rivets and many other forgings are cut from the rod by the shear in the rear of the dies.

The machine is also provided with effective and simple outside shears, which can be used for cutting up stock or for cutting off work from the bar after forging. Back of stationary toggle block is placed a relief wedge, *R*, which can be adjusted to sustain any required pressure, and which will yield to any unusual strain or shock, giving an elastic blow to the forging dies and also preventing any breakage of the machine or parts by careless operator allowing cold work getting between the dies or out of the grooves. The same system is used in connection with the heading punches and is placed on the heading slide in rear of tools. Stationary die-block, movable die-block, toggle arms and toggle blocks are all steel, and the entire construction of the machine is the best that special tools, skilled work and efficient superintendence can make it.

The stock gauge is also a new and valuable feature, remaining in front of the dies until they are entirely closed, and then moving out of the line of the heading tools, with a smooth and easy action in less than $\frac{1}{30}$ of a revolution of the machine.

The illustration is from their 1¼-inch standard machine. Weight, complete, about 13,000 pounds.

Our Directory.

We note the following changes since our last issue. Our readers will do us a great favor by giving us prompt notice of any changes that may come to their knowledge of any error that may be noticed in our list.

Alabama Midland.—Mr. Bradford Dunham has been appointed superintendent.

American Midland.—T. B. Sergeant to be general superintendent, office at Findlay, O.; J. A. Phelps to be auditor; R. L. Ettenger to be superintendent of motive power.

Atchison, Topeka & Santa Fe.—W. G. Tuller to be purchasing agent, vice A. C. Armstrong, resigned.

Baltimore & Ohio.—Robert A. French has been appointed superintendent of the Romney branch of this system.

Canada & St. Louis.—W. J. Fox, general superintendent of the St. Louis, Sturgis & Battle Creek, has had his authority extended over this railroad.

Canadian Pacific.—Roger Atkinson to be mechanical superintendent, vice F. R. F. Brown, resigned to take presidency of Dominion Bridge Company.

Chattanooga, Rome & Columbus.—George Skinner to be superintendent; office at Rome, Ga.

Chesapeake & Ohio.—George Tozzer, late of the Big Four, has been appointed purchasing agent, in place of A. S. Emmons.

Chicago & Northwestern.—Otto L. Miller to succeed Chas. Murray, superintendent Galena Division, deceased.

Cincinnati, New Orleans & Texas Pacific.—F. C. Smith has been appointed division master mechanic at Chattanooga, Tenn., succeeding Mr. J. H. Magill.

Columbus, Hocking Valley & Toledo.—Samuel Davis has been elected vice president and general manager, in place of W. P. Shaw resigned.

Eastern of Minnesota.—F. S. Cruger appointed treasurer and purchasing agent.

Fort Worth & Denver.—J. F. White to be master mechanic, vice E. P. Henderson resigned.

Fort Wayne, Cincinnati & Louisville.—W. W. Worthington, general superintendent, resigned.

Gulf, Colorado & Sante Fe.—H. R. Irvine to be division superintendent, vice J. M. Phillips resigned.

Illinois Central.—E. T. Jeffery, general manager, resigned.

Montana Central.—W. B. Green has been appointed assistant general superintendent.

New York, Lake Erie & Western.—J. H. Parsons, of the western division, has been tranferred to the Susquehanna division. M. W. Maguire has been promoted from trainmaster to superintendent by the western division.

Northern Pacific.—G. W. Dickinson has been appointed assistant general superintendent of the western divisions, with headquarters at Helena, Mont. Charles McMasters has been appointed assistant superintendent of the Rocky Mountain division.

Ohio Valley.—W. W. Hageman to be general superintendant, vice James Montgomery resigned; R. E. Fleming to be purchasing agent.

Oregon Short Line & Utah Northern.—G. M. Cumming to be general manager, W. W. Riter to be superintendent Utah division. W. E. Green has been appointed superintendent of the Idaho division, with office at Pocatello, Idaho, vice S. Rapelje, resigned.

Pennsylvania Railroad.—F. Ellmaker to be division superintendent Philadelphia & Erie, vice Alfred Walter, resigned.

Rome, Watertown & Ogdensburg.—Acting General Manager E. S. Bowen has been made general manager in place of H. M. Britton, deceased. E. Van Etten to be superintendent Western division.

Rome of Georgia.—J. R. Shaler, general manager, and W. F. Ayer to be superintendent.

St. Louis & San Francisco.—E. T. Smith to be purchasing agent, vice E. P. Wherry, resigned.

St Paul, Minneapolis & Manitoba.—A. L. Mohler to be general manager, vice Allen Manvel, resigned; P. P. Shelby to be assistant general manager, H. James to be superintendent northern division, vice R. W. Bryan transferred to Breckenridge division.

Texas & Pacific.—M. W. Elliott will act as superintendent of motive power and rolling stock, with office in Dallas, Tex., vice H. N. Burford, deceased.

Western New York & Pennsylvania.—Robert Bell has been made general manager in place of George S. Gatchell, resigned, and E. A. Fisher, heretofore in the engineering department of the road, has been appointed superintendent of the Pittsburgh division, in place of Mr. Bell.

Zanesville & Ohio River.—C. M. Wicker to be president, vice Chase Andrews, resigned; George F. Gardner, superintendent; Nathan Wright, master mechanic, with headquarters at Fair Oaks, O.

Employment.

Wanted.—Well known traveling salesman to solicit the adoption of the Butler Drawbar Attachment by railroad and car companies, for which service they may take either an interest in the business or receive a commission. Address W. W. Hayward, Secretary Butler Drawbar Attachment Company, Chicago, Ill.

Wanted.—Situation as foreman boiler maker in a railway shop or locomotive works. Best of references. Address J. T. Connelly, Box 166, Huntington, W. Va.

NATIONAL CAR LOCOMOTIVE BUILDER

NOVEMBER, 1889.

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The Louisville, St. Louis & Texas has placed an order with the Pittsburgh Locomotive Works for two consolidation engines.

The Denver, Fort Worth & Texas has ordered from the Baldwin Locomotive Works 10 consolidation engines, with 20 × 24 inch cylinders.

The Pullman Palace Car Company is so crowded with business that it has been compelled during the past month to decline contracts for 2,000 cars.

The charter of the Richmond Locomotive and Machine Works has been amended, so as to allow the company to increase its capital stock to $2,500,000.

The Barney & Smith Manufacturing Company, of Dayton, O., has just completed two handsome dining cars for the Cleveland, Cincinnati, Chicago & St. Louis.

The New York, Lake Erie & Western has placed an order with the Baldwin Locomotive Works for three 10-wheel passenger engines, with 20 × 24 inch cylinders and 68-inch drivers.

An order for fifty 35-foot coal cars has just been completed at the shops of the Illinois Central, at McComb, Miss. Work will soon commence at these shops on twenty-five stock cars, 35 feet long.

The Wheeling & Lake Erie has awarded the Terre Haute Car and Manufacturing Company the contract for building 250 coal cars, and the Peninsular Car Company, of Detroit, has received an order for a similar number.

The Canadian Pacific Railway Company will run a train across the continent in four days, from ocean to ocean, expressly for carrying the mails. Fourteen locomotives will be run on the experimental trip, each covering about 250 miles.

The first engine built at the Omaha shops of the Union Pacific since Mr. G. W. Cushing became Superintendent of Motive Power has been finished. Three more are now being built at the shops, and will be completed within two months.

The Pennsylvania Company has given an order for 200 stock cars to the Missouri Car and Foundry Company. These cars will be equipped with the standard brake rigging lately adopted by the M. C. B. Association and Janney couplers.

The Grand Trunk is erecting workshops at Peterboro, Ont., which, it is expected, will be completed this month, when the present shops at Uxbridge will be closed. It is the intention of the company to concentrate the work of the Midland Division at Peterboro.

It is said to be the intention of the Northern Pacific Company to build a handsome union depot at Minneapolis, Minn., to be used by the Northern Pacific, Minneapolis & St. Louis, Wisconsin Central, Chicago, St. Paul & Kansas City, and, possibly, the Minneapolis, St. Paul & Sault Ste. Marie roads.

The English capitalists have turned their attention to Pennsylvania manufacturers. Manager Hildrup, of the Harrisburg Car Company, has received a letter from C. A. Avery, of New York, offering $500,000 for the plant, and has requested the stockholders to notify him of their wishes in the matter.

With the large high-speed locomotives that do so much work on the New York Central, there has been more or less trouble with the cast-iron axle boxes breaking, and Mr. Buchanan has been trying bronze with decided success. There is now a likelihood of this material being adopted as the standard for all passenger locomotives, and its use may be extended to all classes of engines.

The chronic car famine on the Pittsburgh railroads might suggest a doubt as to the wisdom of abandoning the old policy which permitted shippers to furnish their own cars. Since that liberty is now denied there is a good deal of force in the claim that the railroads are under obligations to provide rolling stock enough to meet all regular demands upon them.

The State Commissioners have granted the Central New England & Western Railroad Company an extension of the time in which they are required to equip their passenger cars with steam heating until Nov. 1. The same extension has been made in the case of the Pullman Palace Car Company, on the representation that it has but 18 cars running in the State which are not yet so equipped.

The final transfer of the Minnesota Car Company's property to the Minnesota Iron Car Company took place at Duluth, Minn. George W. Ettinger becomes treasurer and R. L. Ettinger general manager of the new company. The capital stock is $2,000,000; cash paid in, $1,000,000. The works, which cover several acres, are of the most modern construction and filled with the latest improvements in their line of machinery.

Master Car Builder Robert Miller, of the Michigan Central, states that the private car of President Ledyard, which stood the rear collision at Palatine Bridge with so little damage, was no stronger than any of the passenger coaches which are now built in the company's shops. He claims that the strength of the car was chiefly due to the avoidance of mortises in the end sill and the use of oak plank for the sides of the car from the window sill down.

The Canadian Pacific will erect large works at Hochelaga, near Montreal, for manufacturing the company's own rolling stock. The shops will consist of wood and iron working and erection shops, and an extension foundry to make castings and car wheels. The works are expected to be in operation by Jan. 1 next. The company has for some time been building its own locomotives at the Montreal shops, where there are facilities for turning out a locomotive every five days.

The shops of the Denver, Fort Worth & Texas are situated about a mile from the city of Denver. They consist of a roundhouse, machine shop and blacksmith shop—all built of stone. At present they are being somewhat enlarged, and when completed the main shop will be 60×120 feet. The blacksmith shop is 40×80 feet. About 200 men are employed. The shops are heated by steam. An order for about $25,000 worth of machinery for the machine shops has been placed with Messrs. William Sellers & Co., of Philadelphia, consisting of lathes, steam hammer, wheel grinding machines, slotters, etc.

The Chicago, St. Paul & Kansas City Railroad are building at their shops at South Park a handsome officers' car. The interior finish is entirely in light-colored woods and all the appointments are complete and modern. The exterior is painted Tuscan red, the standard color. It has the turtle-back roof, and is mounted on two four-wheel trucks with 33-inch paper wheels. Until recently all the passenger cars, including the sleepers, owned by the company, had the mahogany outside finish, first introduced on the Canadian Pacific some years ago; but the cars are now being painted as fast as they come in.

When Dr. Williams was appointed general superintendent of the Pennsylvania Railroad, it is said that he asked his friend Mr. John Laird, who was then superintendent of motive power, what kind of people they were on the road. Mr. Laird was a great Scripture reader and he said the Pennsylvania men were truly described in II. Corinthians x. and 12. The verse reads, "For we dare not make ourselves of the number, or compare ourselves with some that commend themselves; but they measuring themselves by themselves and comparing themselves among themselves are not wise." Of course, that was the Pennsylvania of the past.

Miss Frances E. Willard has been trying to induce the Pullman Car Company to abolish the smoking-rooms of the "sleepers." As the smoking-rooms are entirely separated from the rest of the car the only ground of objection to them must be that they contribute very greatly to the comfort of masculine travelers. But Miss Willard says that she can detect faint odors of cigar-smoke in the body of the car, and on that plea she insists upon the total extinction of masculine comfort. Her case is like that of the lady who complained to a baseball manager that the robing-tent was so placed that she could see the players in too scanty costume from her windows, and when the tent was removed to the further end of the field wrote thanking the manager for his courtesy, but added that it was of no avail, inasmuch as she could still see what went on in the tent by using her opera-glass.

The Schenectady Locomotive Works about eighteen months ago built a-ten wheel engine for the Michigan Central as an experiment to handle the fast heavy passenger trains operated by the company. The engine had cylinders 19 × 24 inches, a very large boiler and the fire box set on top of the frames. The total weight of the engine was about 60 tons. She worked so satisfactorily in the prompt handling of trains, and saved so much coal over the eight-wheel engines that had previously been on the service, that the Michigan Central Company have now determined to put locomotives of this kind on all their fast passenger trains. They have received six of these ten-wheel engines, and have ordered five more to be delivered as soon as possible. The Schenectady people are now very busy. Among the latest orders received are nine 18 × 24 moguls for the Illinois Central, and ten consolidations 21 × 24 for the Chesapeake & Ohio, and weighing 65 tons.

At the last Master Car and Locomotive Painters' Convention, Mr. J. W. Houser gave the following notes of his practice in inside finish of coaches: There is a great difference of opinion throughout the country as to filler. Our method of preparing it is as follows: 25 pounds of kalsomine, 1½ gallons coach japan, ½ gallon raw oil. Mix it thoroughly by running through the paint mill, reduce with turpentine to the desired consistency, apply with a partly worn brush, and when set sufficiently, clean the flat surface with a wide glazing or putty knife, the molding with sticks and waste. When dry follow by sandpapering lightly, then give one coat of good inside car varnish, putty the next day, allowing same from 36 to 48 hours to harden, afterward sandpaper and follow with two coats of varnish, allowing 48 hours between coats. I sometimes only give a coach two coats of varnish on account of being pushed for time, but always prefer three coats, allowing it to stand from three to five days before rubbing and oiling.

In giving railroad reminiscences to a meeting of railroad men lately, Mr. C. W. Bradley, general superintendent of the West Shore, gave the following particulars of how business was managed at the principal freight terminus of the Erie years ago: Conductors in those days made up their own trains and switched them, checked their own bills and selected their engines for the trip. The unwritten rule of the service was that the first man on an engine in the engine house at Piermont was the man entitled to the engine for the round trip to Port Jervis and return. There was all the difference in the world in engines, and there was great rivalry among the conductors to get the best engine. I have heard there was a young conductor in the service who would, as soon as he had his supper, make his way to the old engine house and make up a bed in the cab of his favorite engine, and sleep there until the engineer came to take her out. Many of the older men in the service would curse him for being so vigilant in getting the favorite engine.

The railway car in which "Honest Abe" Lincoln rode from his home to Washington to take his first oath as President of the United States is going to decay. The car is No. 540, and is the property of the New York Central & Hudson River Railroad Company. It is now run on the Fall Brook road daily between Wellsboro and Antrim, and used as a common smoking car. The car may be seen any day in the week between trips on a side track at the Delaware, Lackawanna & Western passenger station in Elmira. It is worn and weather-beaten externally, and has the appearance of being an emigrant passenger coach. It was built at the West Albany shops 30 years ago and at that time was considered the acme of railway coach architecture. The seats are stiff and uncomfortable, with iron arms. The arrangements for ventilation and heating were very crude, but this lack of comfort was made up in the gaudy decorations that adorn the paneling overhead. Landscapes and railway views are depicted in high colors, with more or less accuracy, while really good oil portraits of Washington and Lincoln are painted on the end panels of the car.

The degree of artistic beauty to which interior decoration can be carried is but faintly appreciated by the general public. Marble is not susceptible of the same harmonious combinations and pleasing effects as are hard woods, skillfully placed by the artist in such matters. Hand carvings, of course, properly distributed, add greatly to the ornamentation of a room, while the moldings, casings, friezes, door jambs, etc., under the skillful manipulation of modern machinery, embellish the general effect in even a more pleasing manner than did the hand-carved work in days of the *renaissance* and earlier years. There is an exhibition of the products of a marvelous piece of machinery at the Exposition building in Chicago. The machine is called a geometrical wood-carving machine, and runs at a speed almost equal to that of the ordinary planer, thus affording a beautiful product in casings, moldings, panels, ceilings, wainscoting, etc., at a very moderate cost. Hard wood is ornamented with almost as great facility as the pine and cypress. The character of this work is of such high order that it promises to become universally popular.—*Lumber Trade Journal.*

CROSSING THE ATLANTIC.

Editorial Correspondence.

To begin my story in the old-fashioned Robinson Crusoe style, on September 25 I sailed from New York on the good steamer "Trave," Captain Willigerod, of the North German Lloyd line, bound for Bremen. At seven o'clock in the morning of that day the brave ship was steaming down New York harbor, and I, like many other forlorn individuals, was making frequent sorties on the rain-steeped decks to observe the appearance of the people who were to be my company for the coming eight days. The observations were, on the whole, very satisfactory. There was a goodly list of passengers for this season of the year, and they were a highly respectable-looking party, with an unusually small proportion of the genus drummer, whose antics on shipboard are often sufficient to make the life of a retiring man a season of tribulation.

Personally, I found the prospects of a pleasant voyage all that could be desired. There was excellent, light, roomy accommodation provided; and I had a genial companion in Mr. A J. Pitkin, who is of a kind that will talk in season and will help to maintain golden silence when the tired spirit longs for rest. We had also on board Dr. E. H. Williams, of the Baldwin Locomotive Works, as genial and interesting an associate as ever walked the deck of an ocean steamer. We are now nearing the end of the passage, and while finishing the pleasantest sea voyage I have ever made, I wish to bear testimony of the obligations many of us have been under to Dr. Williams. He has been all over the world and has the faculty of seeing what there is to be seen and of remembering all that is worthy of being remembered. Add to that a memory which appears to lose nothing and you have a man whose company beguiles time so effectually that a week's voyage passes like a single day.

A trip across the Atlantic can now be made so quickly and so comfortably that many business men take it annually as a holiday, and the practice of doing this is greatly on the increase. I used to think that there was a great deal of foolishness and worship of fashion in the practice that Americans have of going to Europe as a holiday, but I am now inclined to modify my opinion. Many who go to visit the celebrated scenery of the Old World have seen almost nothing of the noble scenery of their own continent, and it looks as if they ought to begin with the home productions. But this view does not cover the case. There are many men so much bound to business that they cannot get entirely away from it if there is a telegraph office within reach. There are no telegraph offices on the Atlantic, and the seven or eight days spent in crossing is an enforced rest to those who cannot take it in any other way. The mental rest is bound to be beneficial, even though the stomach is subjected to unusual labor.

It is amusing as we steam down the river and out the bay how buoyant, and hopeful, and jolly men become who are nearly all the year oppressed with a heavy burden of business. They walk the deck with elastic step, expand their lungs with big draughts of the bracing saline air, and declare "Ah, this makes a fellow feel good." As the ship gets farther out into the sea, and the rippling billows begin to roll her gently round, our green voyageur finds that a reclining chair is a source of infinite comfort. About this time the dinner gong sounds, and the bracing breezes having stimulated his appetite, he gladly finds his place at the table and sits bravely through all the courses, enjoying everything offered. After an hour and a half of gastronomic pleasure, he returns to the promenade deck and the reclining chair. "How delightful," he says, "it is to be rocked gently in the cradle of the deep," and he is inclined to wax poetic. About an hour afterward his poetic mood has departed, and he is ready to dispense with a little of the rocking. In a little while more he crawls sadly to the rail and dispenses with the dinner that he had enjoyed so much an hour or two before. The glistening, rolling, playful waves have lost all their beauty; the bracing breeze and the air faintly perfumed by the sea are nothing now to be commended. With leaden steps our subject pursues his way to his stateroom, and the couch there with sundry conveniences at hand are his only comforts for the next few days. Sympathizing friends look in, and each offers his favorite remedy, which was never known to cure any one. He tries them all, and conceives a secret repugnance for the author of each, but it is hardly so deadly as the hatred he entertains for the steward a few staterooms distant, who keeps rattling dishes, whose suggestions are taken as a personal insult by the stomach of our subject.

Patience and sleep and clinging to the lounge, etc., and the malady wears away. The steward seduces the patient into the use of tea and toast. He groans aloud that no one will ever catch him coming to sea again if he was only out of this blamed place, and he wonders if it will be possible to go into business in Europe, so that he will not need to return. But he eats the toast, and next time an egg is added, and in another day he gets on deck with his white face and attenuated vest. Convalescence has come, and before he knows it our subject is again among the first to arrive at the dinner table and among the last to leave it. Toward the end of the voyage he acknowledges having been seasick for one day. When he gets home his friends can hardly get him to admit that he was anything worse than a little squeamish the first day.

I have attempted to describe the most common form of seasickness as I have seen it; but the malady has different effects on different men. Some people are sick all the voyage, whether or not there is bad weather. Some people appear to get sick in advance. Anticipation has a good deal to do with the complaint. When I was coming home three years ago there was a young fellow from Buffalo in the stateroom with me who was sick all the time, but not sick enough to prevent him from getting round. He was a great lady's man and all the time was devoting attention to some one of that sex. All at once he would feel suddenly called upon to go below. He would leave his company with a start, rush down the nearest companionway, skip into the stateroom, and almost the first intimation I would have of his entrance would be the sound of his false teeth rattling in the basin. I waited and watched, thinking that some day he would make a sacrifice to Neptune over the side, when woe would be with his teeth; but he always managed to get below and have a margin of 1½ seconds as near as I could figure it out.

Seasickness is such an important subject during a short sea voyage that I must be excused for giving it some prominence in this letter, but I want my friends distinctly to understand that the malady has spared the writer.

We formed a small loco-railroad group on the deck nearly every day, and there were so many questions to discuss and such a variety of stories to tell that the voyage has passed before it seemed well begun. The denizens of a steamer soon settle down into groups, that keep together during the voyage. There are reading people who lounge all day long on the deck folding chairs, and pore over yellow-winged novels oblivious to everything that is going on around them. It is amazing the amount of novel reading and sleeping that some people can get through at sea.

Then there is the nervous, fidgety individuals, who are always gazing for the sight of a sail or a whale or something, and are constantly expressing their belief that something is going to happen. They do not keep together, but circulate among the other passengers like chilis in a bottle of preserves, happy only when they see the agonies of those who are trying to turn their stomachs inside out.

But the important people on board a passenger steamer are the *habitués* of the smoking-room. Their walk and conversation remind me very much of what I used to see and hear in the brakemen's room of an important railroad terminus. Any one who has ever listened to the conversation in a brakemen's room must have been struck with the free and breezy fashion in which that class of railroad employés undertake to settle all matters pertaining to railroad management, from the working out of rates to the designing of the best form of locomotives and the arranging of the next time-card. The poker players of the steamer smoking-room pretend to know more about the navigation of the ship than the captain; they talk as if they knew more about engines and machinery than the chief-engineer, and all shortcomings of any day's run are with the utmost confidence laid on the shoulders of the man to blame. When men have no particular business of their own to attend to it is surprising the ability they develop for meddling with the business of other people.

There is another class of male animal on board who has amusing characteristics. This is the callow, young—ah gentleman, with his—ah valet and his dog. He ought to have his mother, also, to look after him. One of those worthies gave a reading one evening, and the object seemed to be to show how highly polite a reading could be made. The doctor said it reminded him of the young Boston preacher whose prayer was described by a female hearer as the most delightful prayer that ever had been offered to a fashionable audience.

In the intermediate cabins and in the steerage there are other small worlds, each with its own peculiarities; but it would take too much space to go into particular pictures.

I am fond of walking the deck at night especially after the other passengers have retired, and all is quiet except the ceaseless throb, throb of the engines, and all around is a dreary waste of black, rolling water. The ship at that time reminds me, strikingly, of a passenger train rushing along in the darkness. The passengers are all in silent repose; but all the time unseen hands are toiling, and active minds are on the watch, working the vessel along in safety. Away down at the bottom of the ship, in front of roasting furnaces, hard-working men are shoveling coal, and skillful men have their attention on every bearing and pin of the great throbbing engines, careful to see that no link of the train of mechanism that propels the vessel shall miss the drop of oil or the tightening touch which secures immunity from delay or accident. Then up on the bridge where the wind howls, the rain dashes unchecked, and the spray from the rolling sea falls, there are vigilant eyes ever, watchful of danger, unceasingly solicitous to guide the vessel safely, and still higher up on a "crow's nest on the foremast other eyes are helping those on the bridge to discover ahead anything which is not the blue water of the ocean.

I have crossed the Atlantic a good many times, but I have never seen a ship better guarded than the steamer "Trave." The vessel is not called a racer, but she worked along at about 17 knots miles an hour, and kept it up, never once shutting off steam from the time she started from New York till she reached Southampton.

The "Trave" was built three years ago on the Clyde, and is a vessel of 6,500 tons burden. Her extreme length is 455 feet, she is 38 feet deep, and has an extreme breadth or beam of 49 feet. She is propelled by triple-expansion engines with cylinders of 44, 70 and 108 inches diameter and 6 feet stroke. They develop an average of 6,600 horse power, but are capable of being run up over 8,000 horse power. To supply the necessary steam there are six double-ended boilers 19 feet long and 14 feet diameter, having in all 36 corrugated furnaces. The boilers have 22,630 square feet of heating surface, carry steam of 150 pounds pressure and 150 tons of coal a day are consumed in their furnaces. There are 77 men belonging to the engineer's department, viz., 7 engineers, 8 assistant engineers, 2 storekeepers, 3 head firemen, 27 firemen and 30 coal handlers. The men go on watch for 4 hours, and are off 8 hours. Besides the main engines there are electric engines and machinery, hoisting engines and a great deal of other machinery that has to be looked after by the engineering department.

Besides the chief engineer and his subordinates there are 119 of a crew on board, making the entire roll 196 persons.

When full loaded the vessel carries besides cargo, 318 cabin and 600 steerage passengers.

A steamer, besides being like a railroad train on a large scale, is a hotel also, and an immense quantity of eatables has to be provided to feed the passengers, Through the kindness of the purser of the "Trave" I got a list of the food supplies for a full-loaded voyage. Among the important items are 18,300 pounds of fresh beef, 12,760 pounds fresh veal, 2,500 pounds fresh lamb, 1,100 pounds fresh pork, 1,822 pieces of poultry, 1,200 pounds of fresh fish. Then there are large quantities of canned meats and vegetables, and no end of hams, dried beef, cured fish, etc. There was over 6,000 pounds of bread in loaves, and 51 barrels of flour were used up in various ways. To mix the solids they used up the brewing of 54 pounds of tea and 590 pounds of coffee. For various purposes they used up 347 cans of condensed milk and 150 bottles of fresh milk. Eggs in all forms make a favorite article of diet at sea, and 10,610 were required during the voyage. In the line of vegetables they used up 310 barrels of potatoes, 150 barrels of cabbage, 500 pounds of string beans, 28 boxes of onions, besides the canned vegetables that are too numerous to mention. The list of food supplies contains over 120 items, and every thing that is supplied to the table of a first-class hotel is upon it, including fresh turtle. It was surprising, the extent and variety of fruit that was provided. They consumed 400 pounds of ice cream and 59,000 pounds of ice were used. For cooking and other purposes 40,000 gallons of fresh water were used, all of which was brought from the shore in tanks.

This line of steamers is rapidly increasing in popularity, and the company are pursuing the right course for gaining the favor of passengers. Veteran travelers say that the table is the best provided on any line crossing the Atlantic, and I believe this to be true. But perhaps better than the finely-served menu is the kindly attendance to the wants of passengers shown by the stewards. When a traveller is not feeling so well as he would with his foot upon his native mud, it makes a great difference to have an attendant doing his level best to alleviate his misery. Small attentions have a wonderful influence in making the world look brighter at sea.

Since I began writing, the rocks of the Isle of Scilly have appeared in view, and everybody appears happy, and there is wonderfully little grumbling. We came on board intending to go to Bremen, but the sight of firm land has been too much for the perseverance of my companion. He is anxious to know how it feels to have one's feet on solid ground again, and we must needs land at Southampton. On the whole, it is pleasant to get ashore; and in looking forward to deserting the ship soon, I would express the hope that any of my readers who may be anticipating a trip across the great pond may have as delightful a time as I have enjoyed.

A. S.

In these days the profits that may accrue from a new and useful invention that becomes popular are immense. On the other hand, much valuable time might be saved by bearing in mind the advice said to have been given by a Chicago patent lawyer. He says: "My advice to my private friends is to have nothing to do with inventing things for patents. It is more absorbing, more disappointing than gambling. Not one in a thousand inventions are 'new and useful,' and not one in a thousand of those that are 'new and useful' are ever introduced. The Patent Office contains already a million or more splendid devices that have never been put on the market. If, however, you are bent on inventing something, I have additional advice to give you. Don't waste your time and money on devices that are ornamental and luxurious, or simply convenient. The only inventions that are profitable are money-saving devices; and if you find your mind running on any other, stop it at once. Don't spend too much thought and money before you have found out whether it is new or not. The probability is that it was patented twenty years before you were born, and is absolutely worthless. If you ever happen to stumble on anything good, don't file a caveat. That will simply give you away without protecting you against fraud."

Compound Locomotives.*

BY PROF. ARTHUR T. WOODS.

Third Paper.

GENERAL ARRANGEMENT OF PARTS.—While the disposition of cylinders and steam chests with regard to the boiler and running gear in two-cylinder compound locomotives does not differ from European practice in simple locomotives, the same diversity of design, which has heretofore been remarkable in that as compared with American practice, is found in their compound locomotives. The designer will thus find precedent in existing engines for almost any arrangement of the principal parts, and for any type of valve gear which he is likely to adopt.

The credit of having inaugurated the present era of compound locomotives in Europe is due to Mr. Anatole Mallet, who designed successful two-cylinder compound locomotives for the Bayonne & Biarritz Railroad in 1876, and has since brought out many different designs. While it would not be incorrect to class the greater number of compound locomotives as belonging to the Mallet system, this term as applied to two-cylinder engines is usually restricted to those which can be operated either as simple or compound engines at the will of the engineer, as distinguished from others which are necessarily worked as compound engines, except for a brief interval in starting.

Engines of the latter class have been built in considerable numbers since 1880, especially after the designs of Mr. A. von Borries, Locomotive Superintendent of the Hanover Railroad, and Mr. T. W. Worsdell, Locomotive Superintendent of the Great Eastern Railway, England.

This class of engines comprise what is known as the Worsdell and von Borries system, the essential difference between their designs being in the method of accomplishing the automatic change from simple to compound working.

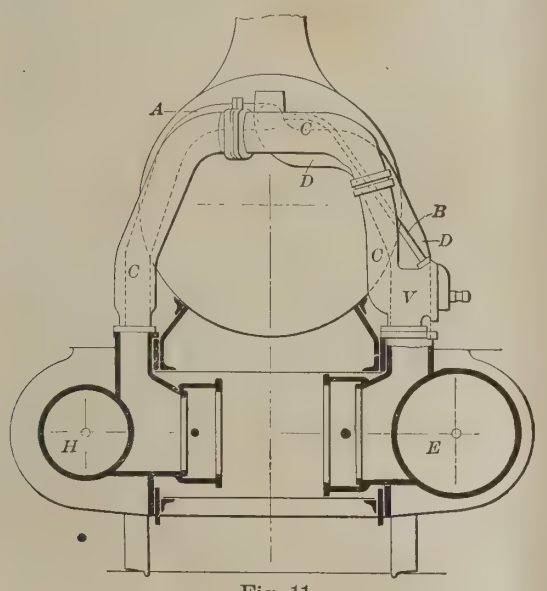


Fig. 11

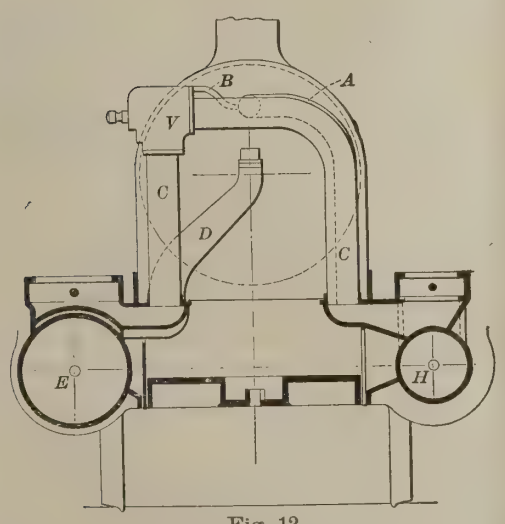


Fig. 12

THE VON BORRIES SYSTEM.—Figs. 11 and 12 illustrate the arrangement of cylinders and steam connections in two designs of compound locomotives according to the von Borries system. In both figures *h* is the h. p. cylinder, *l* is the l. p. cylinder, *A* is the steam pipe from the boiler to the h. p. cylinder, *C* is the receiver connecting the two cylinders, *V* is the starting and intercepting valve, *B* is the auxiliary steam pipe from the boiler to the starting valve, and *D* is the exhaust pipe from the l. p. cylinder. It will be noted that in Fig. 12 the steam pipes, receiver and exhaust pipe are almost entirely inclosed in the smoke-box, and it is very desirable that they should be so placed.

The arrangement in Fig. 11 is that of a six-coupled freight engine for the Prussian State Railways, which was illustrated in *Engineering* of Feb. 1, 1889. The dimensions, which are of immediate interest in this connection, are as follows:

Diameter of high-pressure cylinder	18.1 in.
" low-pressure "	25.6 "
Stroke of pistons	24.8 "
Diameter of driving wheels	52.4 "
Boiler pressure, gauge	174. lbs.
Diameter of boiler, smallest inside	50.8 in.
Tubes, 184, 2-in., length	14 ft. 7 in.
Grate area	16 sq. ft.
Heating surface	1,420 "
Weight in working order, all on driving wheels	88,250 lbs.
Valve gear	Allan.

Fig. 12 is taken from a paper on Compound Locomotives by Mr. R. Herbert Lapage, read in November, 1888, before the Institution of Mechanical Engineers (England), and illustrates a four-coupled passenger locomotive of the Santa Fé & Cordoba Great Southern Railway. The principal dimensions are as follows:

Diameter of high-pressure cylinder	16 in.
" " low-pressure "	23 "
Stroke of pistons	24 "
Diameter of driving wheels	66 "
Boiler pressure, gauge	170 lbs.
Weight in working order	86,200 "
Valve gear	Stephenson.

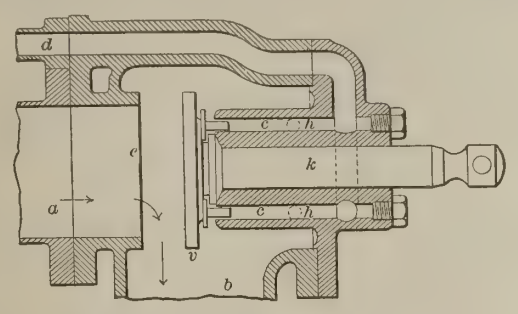


Fig. 13

The essential feature of the von Borries system is the combined intercepting and starting valve, a recent form of which is illustrated by Fig. 13. In this figure *a* is the receiver pipe which leads from the h. p. cylinder and *b* is the passage to the l. p. cylinder. The valve is shown in the position which it occupies ordinarily, or when the locomotive is working as a compound engine, the direction of the flow of the steam being as indicated by the arrows. Connected to the back of the intercepting valve *v* are two small plungers *c c* which together form the starting valve. Supposing the valves to be in the positions shown in Fig. 13 and the engine about to start, when the throttle is opened steam will be admitted to the h. p. cylinder by the usual pipe, and also to the auxiliary steam pipe *d*, and by the passage shown, to the back of the plungers. The pressure on the ends of the plungers is sufficient to move the intercepting valve *v* to the left in the figure until it seats at *e*. By the same movement two small ports *h h* are uncovered, through which steam from the boiler is admitted to the passage *b* and thence direct to the l. p. steam chest, while, as the intercepting valve is closed, this pressure does not act against the h. p. piston.

As the engine starts and the exhaust from the h. p. cylinder takes place, the pressure in the receiver rises until it is sufficient to overcome the pressure on the l. p. side of the intercepting valve, when this valve is moved back to the position shown in the figure, while at the same time the two small steam ports are closed by the plungers, and the engine begins to work as a compound. It is said that in practice the pressure of the steam from the boiler which is admitted to the l. p. cylinder is reduced by wire-drawing, due to the small steam pipe and ports, to about one-half the boiler pressure, and as the ratio of the cylinders is about two, the total pressure on the two pistons in starting is nearly equal. To prevent excessive pressure in the l. p. cylinder and receiver a safety valve is placed on the latter.

The pressure in the receiver when running is sufficient to overcome the boiler pressure acting on the ends of the two small plungers, together with the atmospheric pressure on the stem of the large valve *v*, and, therefore, the valves are maintained in the position shown in Fig. 13 as long as the throttle is kept open. In the paper referred to above, Mr. Lapage states that: "In practice it takes only from half to one revolution before the exhaust from the high-pressure cylinder opens the intercepting valve and closes the starting valves."

It will be noted that according to this statement, an engine with 66-inch driving wheels would begin to work as a compound after moving through from about 8½ to 17 feet. Just how far it will move before opening the intercepting valve will depend upon the positions of the cranks before starting, as will be demonstrated when considering the subject of the starting power. Strictly speaking, these locomotives can never work as simple engines, since the h. p cylinder always exhausts into a closed receiver and never directly into the atmosphere. Mr. Lapage also stated that this automatic starting and intercepting valve had been already applied to about one hundred and fifty engines.

The earlier forms of intercepting valves were not wholly automatic in their action, but required to be closed by hand before opening the throttle in starting. In this form there were no small plungers, and the steam was admitted around the valve stem *k*, which was fluted for part of its length for this purpose. The valve was also connected by a bell-crank arrangement to a weighted arm, which held the valve open and prevented rattling when running with steam shut off.

THE WORSDELL SYSTEM.—Fig. 14 illustrates the arrangement of the cylinders and steam connections of a Worsdell four-coupled compound locomotive for passenger service, drawings for which were published in *Engineering* of March 30, 1888. More recent engines do not differ from this in regard to the cylinders and steam connections.

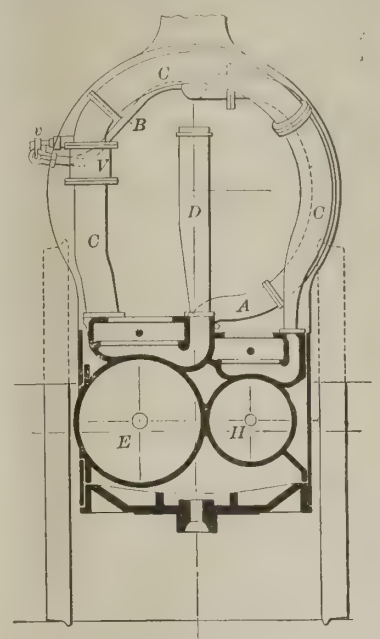


Fig. 14

Fig. 14, *h* and *l* represent the high and low-pressure cylinders, respectively, *A* is the high-pressure steam pipe, *C* is the receiver, *D* is the low-pressure exhaust pipe, *B* is the steam supply to the starting valve *v*, and *V* is the intercepting valve.

The principal dimensions of this engine are as follows:

Diameter of high-pressure cylinder	18 in.
" " low-pressure "	26 "
Stroke of pistons	24 "
Diameter of driving wheels	80¼ "
Boiler pressure, gauge	170 lbs.
Diameter of boiler, smallest inside	53 in.
Tubes, 242, 1¾ inches, length	10 feet 11½ "
Grate area	17.33 sq. ft.
Heating surface	1323.3 "
Weight in working order, total	97,000 lbs.
" " " on driving wheels	68,000 "
Valve gear	Joy.

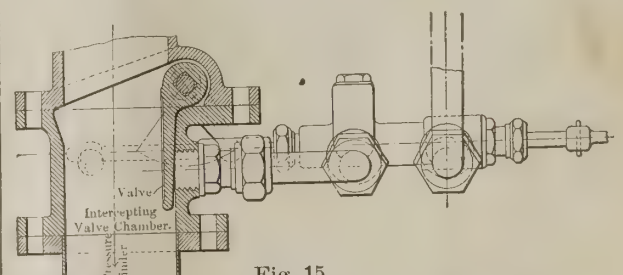


Fig. 15.

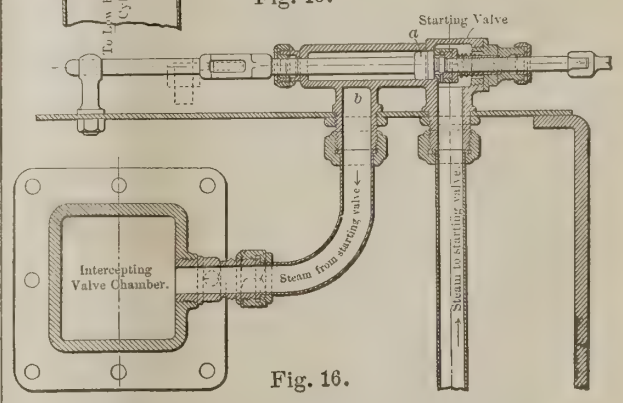


Fig. 16.

The Worsdell starting and intercepting valves are illustrated by Figs. 15 and 16, which are reproduced from *Engineering*. The intercepting valve is a flap valve, and is shown in Fig. 15 in the position which it occupies when the engine is working as a compound, being swung to one side, and thus leaving a straight, clear passage by it. The spindle on which the valve turns passes out through the side of the smoke-box, and carries an arm, which is connected to the small piston shown at *a*, Fig. 16, in a manner which is clearly indicated in the figures. The starting valve casing is connected to the main steam pipe by a small pipe, which is shown in Fig. 16 and also in Fig. 14. The piston *a*, which operates the intercepting valve by means of the connection previously referred to, works in a cylinder which is an extension of the starting valve casing.

A small port, which is covered by a spring-loaded valve, connects this cylinder with the pipe *b*, and thus to the intercepting valve chamber. The starting valve is operated by a lever, and is a double valve, a slight movement of the lever opening the smaller valve, and further motion opening the larger valve, which is then partially balanced.

The operation of these valves in starting is as follows: The starting valve being opened by the engineer, steam, at boiler pressure, acts upon the small piston *a*, and moves it forward or to the left in the Figs. By the same movement the intercepting valve is swung up and closed, and the port connecting with the pipe *b* is uncovered, thus admitting steam from the boiler to the intercepting valve chamber below the valve, and thence to the low-pressure steam chest. As the exhaust takes place from the h. p. cylinder, the pressure in the receiver, above the intercepting valve, rises until it is sufficient to open that valve, when, by its movement, the small piston *a* is returned to

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the position shown in Fig. 16, and the steam supply is thus shut off. It will be seen that the Worsdell starting and ntercepting valves are the same in principle as the von Borries valves, although the former are not wholly automatic in their action.

Valve Gear Adjustments.—In discussing the theory of two-cylinder compound engines, it was shown that the division of the total work between the cylinders could be equalized by maintaining a considerably earlier cut-off in the h. p. than in the l. p. cylinder.

Mr. von Borries finds that in practice for cylinder ratios of from 2. to 2.05 a cut-off of 0.4 in the h. p. cylinder calls for a cut-off of 0.5 in the l. p. cylinder. This adjustment gives a very nearly equal division of the work, and can be made without difficulty or increased complication with the valve gears which are suitable for locomotives, such as the Stephenson, Allan, Joy and Walschaert.

For the American form of the Stephenson shifting link motion, and when the locomotive is to run principally in forward gear, only a very simple change is necessary. It is to make the h. p. link hanger slightly shorter than the l. p. hanger, leaving all other parts as for a simple engine. This causes the h. p. link to be a little nearer the mid position than the l. p. link for all points in the forward gear, the result being to make the h. p. cut-off the earlier of the two as required. For the above cylinder ratios the h. p. hanger should be about one-twentieth of the lift of the link shorter than that of the l. p. gear.

This difference in length, of course, produces the opposite effect in the backward gear, the l. p. cut-off being then the earlier. For this reason the full-gear notch is the only one cut in the quadrant for the backward gear. Mr. von Borries gives the following as the approximate cut-offs which are obtained by this means:

	Forward.					Backward.
High-pressure cylinder.....	75	50	40	30	20	78
Low-pressure cylinder.....	78	59	50	41	32	75

A more detailed tabulation of the distribution effected by this form of adjustment, as applied to the locomotive illustrated by Fig. 12, is appended. This table is taken from the paper by Mr. R. H. Lapage, to which reference has already been made.

Steam Distribution in Compound Locomotive on the Santa Fe & Cordoba Great Southern Railway.

Angle of eccentrics, forward, 60½ degrees; backward, 61½ degrees.

HIGH PRESSURE CYLINDER.

Sixteen inches diameter by 24 inches stroke. Clearance in link top, 0.94 inches; bottom. 0.31 inches. Slip of block, top, 0 81 inches; bottom, 0.69 inches. Mid-gear travel, 2.63 inches. Outside lap, 1.12 inches; inside clearance, 0.25 inches. Length of ports, 12.87 inches; length of link hanger, 14.06 inches.

	Notch in Quadrant.	Travel of Valve.	Lead.	Maximum Opening of Steam Port.	Cut-off, Per cent. of Stroke.	Release, Per cent. of Stroke.
		Inches	*Inches.*	*Inches.*		
Forward gear.	Full	4.19	0.02	1.00	73¾	89½
			0.02	0.94	72¼	88½
	5	3.50	0.06	0.63	61¼	83¼
			0.06	0 62	58½	81½
	4	3.19	0.09	0.47	52¼	78¾
			0.10	0.47	49	76¾
	3	2.97	0.12	0.34	41½	73½
			0.13	0.37	38½	70¾
	2	2.72	0.13	0.24	29½	66¾
			0.16	0 28	27½	63
	1	2.62	0.13	0.16	16½	58
			0.16	0 22	18	54
Backward gear.	For backward gear the full-gear notch is the only one cut in the quadrant.	2.72	0.12	0.25	26½	61¾
			0.13	0.22	20	59½
		2.91	0 10	0.38	37½	69¼
			0 12	0.28	31	68½
		3.09	0.09	0 47	47	75¼
			0.10	0.38	42½	75½
		3 37	0.06	0.62	55¾	79¾
			0.09	0.51	53¼	81
		3.62	0.03	0.74	62¾	83¾
			0.06	0.62	61¾	84½
	Full.	4.26	—0 03	1.07	74	89¼
			0.00	0.95	74½	90½

LOW-PRESSURE CYLINDER.

Twenty-three inches diameter, by 24 inches stroke. Clearance in link, top, 0.31 inches; bottom; 0.94 inches. Slip of block, top, 0.81 inches; bottom, 0.62 inches. Mid-gear travel, 2.56 inches. Outside lap, 1.12 inches; inside lap, 0.00. Length of ports, 17.00 inches. Length of link hanger, 14.64 inches.

	Notch in Quadrant.	Travel of Valve.	Lead.	Maximum Opening of Steam Port.	Cut-off, Per cent. of Stroke.	Release, Per cent. of Stroke.
		Inches.	*Inches.*	*Inches.*		
Forward gear.	Full.	4.50	0.03	1.16	78	93¾
			—0.03	1.09	77½	94
	5	3.72	0.03	0.87	67¼	90
			0.06	0.87	66	89¾
	4	3.47	0.06	0.87	60¼	87¼
			0.09	0.87	57¾	86½
	3	3.22	0.09	0 84	51½	83½
			0.10	0.86	48½	82¾
	2	2.97	0.12	0.72	40	79¼
			0.13	0.74	37¾	78
	1	2.78	0.13	0.61	27¾	73¼
			0.16	0.66	27½	71
Backward gear.	.....	2.62	0.13	0.55	17	62½
			0.16	0.56	13½	61½
	.....	2.74	0.12	0 62	27¼	70
			0.16	0.61	22	70¼
	.....	2.90	0.09	0.72	36¾	75¾
			0.16	0.69	31¾	77
	....	3.12	0.09	0.84	47½	81
			0.13	0 78	43¾	82½
	.....	3.37	0.06	0.87	55½	85
			0.12	0.87	53½	86½
	Full.	3.90	—0.03	0.87	68½	90½
			0.03	0 87	69¼	91¾

For locomotives which are required to run equally well in either direction, the alteration described above is evidently not applicable, but a similar effect is produced by making the mid-gear travel of the l. p. valve less than that of the h. p. valve. This is, of course, readily accomplished by reducing the angular advance for the l. p. eccentrics, the outside lap of the l. p. valve being also made less. For cylinder ratios of from 2.15 to 2.2 Mr. von Borries recommends making the mid-gear travel of the l. p. valve 0.9 of that of the h. p. valve, and reducing the outside lap in about the same proportion. The approximate relative cut-offs thus obtained are as follows, being the same in both forward and backward gear:

High-pressure cylinder.....	75	60	50	40	30
Low-pressure cylinder.....	78	64	55	45	34

Similar variations in the points of cut-off can be obtained with the other types of valve gears which have been mentioned, for example, by placing the arms on the lifting shaft of the Allan motion at an angle with each other, and by inclining the sliding links of the Joy gear. Other minor charges which will produce similar results will naturally occur to the designer.

For inside valve gear and outside steam chests Mr. von Borries advises the use of the American form of the Stephenson motion; for inside gear and inside steam chest, the Stephenson and Allan types; and for outside gear, the Walschaert motion. All of the recent Worsdell engines, concerning which information is at hand, are fitted with the Joy valve gear. The advisable dimensions of valves and ports will be considered later.

Taking up Lateral Wear of Boxes.

When the subject of driving boxes was under discussion at the last Master Mechanics' Convention, Mr. J. S. McCrum, of the Kansas City, Fort Scott & Gulf, excited considerable surprise by telling how he was in the habit of taking up the lateral wear by lining the part of the box subject to rapid wear with babbitt metal. This is a practice followed very successfully on several Western roads, but it is not followed in the East, probably because most of the men in charge of machinery of Eastern roads have more time for doing repairs deliberately. The method looks rather like a crude makeshift, but it is really an economical way of doing the work, and ought to be more practiced than it is, especially where mogul engines and ten-wheelers are used on fast train service, where the lateral wear of boxes is very rapid. In the course of some correspondence we have had with Mr. McCrum about the details of his practice, he informs us that lining with soft metal is very satisfactory, but he would only recommend the best grades of babbitt. He has used magnolia metal for the purpose, and considers that and other good types of anti-friction metal even superior to the best babbitt. The process of applying the metal is thus described. When a box comes in worn laterally, and if the flange on the side of the box is heavy enough, the end next the wheel is counterboned just enough to give the babbitt or other metal a hold. Then some brass pins are inserted in the face, which is carefully tinned over and the metal run in, and afterward the face is planed when the box is ready for service. It makes a very durable job, and the box is as good for service as it was when new.

Another practice, followed successfully on the Missouri Pacific and other Western roads, is to counterbone the box and put in a lining of cast-iron, which is cut in two so that it can be put in place. This is not even pinned to the box, yet it remains in position very well and can be renewed with very little labor or expense whenever wear makes renewal necessary. We believe that a lining of this kind, or of the anti-friction metal recommended by Mr. McCrum, if applied to the rubbing end of steel driving boxes would effectually overcome the objections that have been found to that strong metal when used for driving boxes.

A Convert of the Indicator.

We commented last month on the foolish remarks upon the steam engine indicator made by an ignoramus who happens to be a locomotive builder. Men of that stamp, who, however, will never be made to realize the density of their ignorance, could learn a great many things if they could only be induced to study some good book on steam engineering. Writing on this subject reminds us of some remarks made by the famous Chordal in 1879, when he was writing up a Cincinnati exhibition for the *American Machinist*. He said * * * "These exhibitions always are of value to exhibitors. Old engine builders who never saw an indicator, bring engines to these shows and get their eyes opened. They find that there is a way of getting at the inside of things as well as at the outside. One of our most prominent engine builders crossed the rubicon which bounds scientific engine construction right in one of these old Cincinnati expositions. He brought his engines to show. He was proud of them. They were really the best he knew of. He knew nothing of indicators or of the real scientific basis of construction. When his engines were in the hands of the jury, he saw the said jury apply all manner of instruments in order to diagnose the inwardness of the engines. A hint was enough. From that time to the present this same exhibitor has taken the lead in careful inquiry and conscientious and original construction. The jury showed him faults in his engine which he did not know existed in any engine, and this party has corrected these errors, advanced the art of steam making in several directions, and now stands and works on theoretical ground where angels fear to tread. He not only took up at once with the instruments of the experts, but became dissatisfied with their construction, and designed and made new ones, and set a new model for the world."

The Wagner Car Works.

Great improvements have been effected in and around the Wagner Car Works, at Buffalo, during the last year. The place is greatly improved in appearance, and many new conveniences and means of facilitating work have been introduced. They have lately put in, to meet the requirements of storage, 25 new spur tracks, making in all about five miles of track outside the main buildings. There is about two miles of storage track covered by sheds. During a hurried run through the shops, we found them very busy turning out exceedingly handsome cars of a variety of designs. There were in the different shops boudoir cars that are the best deserving of being called palaces on wheels of anything that we have ever seen. They are intended to form the make up of vestibuled express trains on some of the Vanderbilt lines, and nothing calculated to increase the comfort of passengers has been omitted. They are built with a high arched roof, which in itself greatly adds to the stately appearance of such cars, and the whole vehicle is 76 feet long over the platforms. It is divided into fourteen state rooms and smoking rooms. The inside is finished in mahogany and very tastefully upholstered. Among other work on hand were cars to make up several trains of vestibule sleepers of the company's standard pattern, for the service between New York and Cincinnati and St. Louis and Chicago, over the Big Four's system. The change of ownership displaces the Pullman cars from the Big Four's, but the patrons of the road will have no reason to regret the change, if one may judge by the luxurious fittings of the cars to be seen at Buffalo.

We noticed that the Wagner Company have adopted a new oil journal box designed by Mr. Bissel, general manager of the works, to accommodate the large axle they are now using. The axle has a collar and is 4¼ × 8 inches.

They are working several carving machines very successfully in these works of a kind gotten out by a Milwaukee inventor. They consist of cutting tools held in a frame and worked vertically like a drill, their action being regulated by a blind tool which is passed over the figures of a pattern of the carving to be reproduced. The work is done very rapidly and surprisingly well.

They Said the Time was Too Fast.

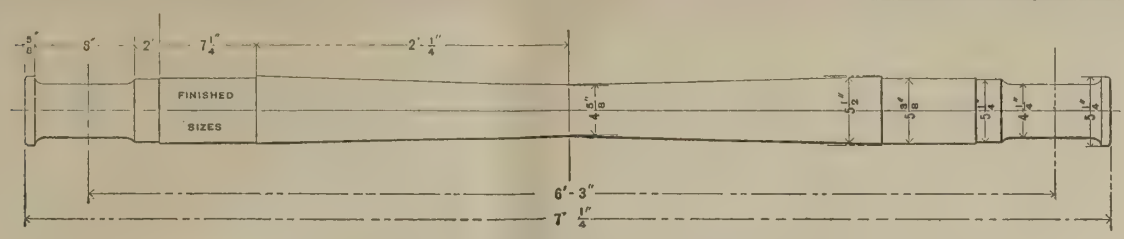
In the early days of the Erie there was little need for superintendents or other officers, for the conductors and engineers were the powers that controlled the operating of the road. Whatever changes were proposed by the nominal officers were taken up and discussed by the trainmen, and if these did not vouchsafe their sanction and support there was no use trying to put them into effect. The engineers and conductors generally agreed that between them all questions relating to operating should be settled; but they often differed grievously between themselves, and their quarrels were at times highly inconvenient to the company. These were halcyon days for trainmen, but they were not so profitable to the company.

About this time Mr. Charles Minot was appointed superintendent. Mr. Minot was a New England lawyer, with strong natural affinities for mechanics. He learned to run a locomotive, and railroad life attracted him so much that he gave up a good law business to become a railroad man. One of his first acts on becoming superintendent of the Erie was to formulate a complete set of rules of train operating. This had not been done before, and the rules arranged by Mr. Minot became the foundation on which nearly all American railroad companies laid their rules of operating.

These rules were of a highly practical character, and every one of them was made to be obeyed. They made no provision for the engineers and conductors interfering with the management, and on this account they gave great dissatisfaction. But Mr. Minot was a strong man, and the rules had to be obeyed. There was a wonderful amount of kicking, but nobody was hurt except an occasional strong head who rebelled. He always got permission to air his grievances elsewhere.

One time Mr. Minot arranged a new time-table, shortening up the time between Claremont and Dunkirk. The passenger engineers, as usual, got considering the time card, and they made up their minds that the time was too fast and could not be made, and sent in a respectfully worded opinion to Mr. Minot to that effect. Mr. Minot's headquarters was in New York, but on the day that the new time-table was to go into effect he took his carpet-bag and went to Claremont. When the engine backed up to couple on to the train he stepped on to the cab and told the engineer that his services were not needed for that run. Mr. Minot ran each engine in succession all the way to Dunkirk and went in there on time. In each case he left the engineer behind.

After performing this feat he brought all the engineers concerned to Claremont for a talk. "Now, boys," he said, "you tell me that this time cannot be made. You see that I have made it. I feel sure that any of the freight men can make it. If you cannot run this train on time, I do not think you can handle our freight trains satisfactorily, and we will not try you there. Boys, the trains are going to be run on time, and if you cannot do it you may go to a road where the trains are slow." They ran the trains all right.



Standard Axle for 60,000-lb. Cars.

ADOPTED BY THE MASTER CAR-BUILDERS' ASSOCIATION, SEPTEMBER, 1889.

The Standard Axle for 60,000-lb. Cars.

The drawings presented herewith show the dimensions of the standard axle which the Master Car-Builders' Association has adopted by its recent letter ballot.

Master Car-Builders' Association.

RESULTS OF LETTER BALLOT VOTES.

A summary of the votes cast on each of the questions submitted is given below, together with the results of the ballot.

Subjects voted on.		Question.	Number votes cast: Affirmative.	Negative.	Total.	No. votes necessary for adoption.	Results of votes.
Fletcher journal box lid.	Fletcher lid	A	370	107	477	318	Adopted.
	Form of	B	266	211	477	318	Rejected.
Cast iron wheels.	Specification	C	362	83	445	297	Adopted.
	Guarantee	D	312	128	440	294	"
Axle for cars of 60,000 pounds capacity.	Diam. journal	E	440	33	473	316	"
	" wheel seat	F	440	33	473	316	"
	" center	G	439	34	473	316	"
	" collar	H	440	33	473	316	"
	" dust guard	I	440	33	473	316	"
	Length journal	J	473	0	473	316	"
	" wheel seat	K	403	70	473	316	"
	" dust guard	L	438	35	473	316	"
	" collar	M	468	5	473	316	"
	" C to C journals	N	438	35	473	316	"
	" over all	O	433	44	477	318	"
	" as per drawing	O'	371	86	447	298	"
Brake gear for air brake	Max. pressure	P	434	30	464	310	"
	" power	Q	434	30	464	310	"
	Arr. as per sheet 3	R	435	29	464	310	"
	Details " 2	S	429	35	464	310	"
	Cocks and couplings	T	435	29	464	310	"
	Strength brake beams	U	363	97	460	307	"
	Brake shoes	V	413	51	464	310	"
M. C. & B. draw-bars and carrier irons.	Draw-bar 30 in. long	W	443	25	468	312	"
	Draw-bar 28 in. long for repairs	X	338	137	475	317	"
	Size at neck, 5 in sq.	Y	408	67	475	317	"
	Tail end as per sheet C	Z	347	128	475	317	"
	Carrier irons, 5½ in. × 5¾ in.	&	407	51	458	306	"

JNO. W. CLOUD, Secretary.

RAMBLES ON EUROPEAN RAILWAYS.

Editorial Correspondence.

PARIS, Oct. 10, 1889.

After a hurried journey through several countries we have arrived in this city of monuments, of palaces, the Exhibition and the Eiffel tower. The importance of the celebrated institutions mentioned are in the inverse way to which they are put, if one is to judge of them by the prominence they hold in common conversation, but all are important enough and interesting enough to satisfy the sight-seeing desires of the most exacting of travelers. It is not my intention at present to attempt giving our readers any particulars about this exhibition further than to say, that it is the most stupendous collection of industrial and art products that have ever been displayed together, and that the buildings which hold the collections are magnificent beyond parallel. The Eiffel tower, the highest structure ever erected by human hands, is a monument worthy of the collection it looks down upon.

A week ago to-day we landed along with about sixty others at Southampton. We were put ashore by a tug about three o'clock in a raw semi-rainy morning. We were all marched into a warehouse to have our baggage examined by the customs officers. As the pieces were passed, they were thrown on to wheelbarrows; and when one of these homely, if useful, vehicles was loaded, the man hauling it called upon the owners of the trunks, bags and bundles to follow him, and soon there was a procession of big wheelbarrows followed by pensive men, women and children moving slowly through the silent streets toward the railway station. If we had landed a little earlier, a special train would have taken the party to London, but as we were too late for that, we had to wait at the station for the regular train at 7. There were one or two jets of gas lighted in the waiting room, so we could see to stand round, and most of us did so, very patiently. The porters were also very kind and permitted those who preferred to do so to go into the carriages composing the train. About 6 a young lady of very prepossessing demeanor, whom some of the young men had the audacity and temerity to address as "Martha." opened up the refreshment bar and displayed a readiness to minister to the wants of the waiting crowd. With great alacrity the men, women and children composing the crowd got up to the counter and partook of whatever they could find to make a breakfast of. Necessity is a great leveler. Some of the passengers were very luxuriant in their tastes when on board the "Trave," but at the railway station they stood round and partook of fourth class viands with surprising avidity.

The train that took us to London was of a kind that we are all very familiar with. It was a local, and stopped at every station. It did not differ much from the locals of the American continent, even in reaching the terminus fifteen minutes late. There were fourteen small carriages, and the train was pulled by a six-coupled engine with driving wheels about five feet diameter. The man in charge thought the cylinders were 18×24 inches. The road is practically level.

After spending the day in London, where our first business was to purchase umbrellas, that were badly needed, we left Charing Cross station at 8:15 P. M. provided with tickets for Dusseldorf, by way of Calais and Brussels. As we were getting the tickets, my companion, who is always looking ahead, said to the clerk: "Will you please telegraph to Calais to secure us berths in the sleeping car?"

"Telegraph to secure you sleeping carriage berths," exclaimed the clerk, with accents expressing the greatest surprise, "I never 'eard of such a thing." We did not secure berths in advance.

The next surprise that my companion got was seeing the guard of the train thankfully accept a shilling for some little attentions bestowed. He got bravely over being surprised at anything before we reached Paris.

After being well shaken up in the miserable little steamer that tortures night passengers in the passage of the Straits of Dover, we hurried into the sleeping car that was in the train on the Calais pier. It was a car about 30 feet long, divided into small compartments like the rooms in a Mann sleeping car, but much smaller, the facing beds being only about 30 inches apart, and each bed about 2 feet wide. We went into the first room we reached, and the combined conductor, steward and porter followed us in. He received our fares, and said that we could have the whole of the room. There was some luggage on one of the beds when we entered. The porter removed that, and said that we might lock the door and retire. We did so, and had scarcely got undressed when there was a loud knocking at the door. Then a statement was made in very sententious English that the room had been taken by the speaker, and why the blank was the door locked. The conductor, etc., protested in voluble French that he did not comprehend, and the English-speaking voice indulged in some decidedly strong expressions of disgust at everything to be found in France, especially sleeping cars and this particular porter. As we had not had any sleep the previous night, we both sank tranquilly into the arms of Morpheus, and what was the outcome of the misunderstanding remains one of the unsolved mysteries of our journey.

We were not, however, to escape without misunderstandings of our own. About 7, the porter awoke us and intimated that coffee was ready, which he immediately brought in. This we admitted to be an admirable custom. When we had got our courage fortified with coffee and some light etceteras, the porter gently informed us that our tickets were not good for the month of October, and that we would have to get off at Verviers to receive explanations, and that we would have the pleasure of paying the fare from Calais. It was a pleasure that we were quite ready and willing to forego. But on our arrival at Verviers we were surrounded by a most imposing representation of Belgian authority and escorted in grand state to the office of the assistant station-master. We informed that dignitary that we had already paid our way honestly to Dusseldorf, and we were not inclined to expend any more money for the privilege of being carried there. He then led us to the office of the head station-master, all the uniformed crowd following, most of them during the interview that ensued being extremely ready in offering suggestions and advice. We utterly bankrupted our stock of French trying to convince the chief station-master that it would be unjust to impose the payment of duplicate fares upon strangers in a strange land, but he always returned the uncompromising answer, "Pay from Calais and take tickets to Dusseldorf." Various members of the uniformed crowd would repeat this with variations, and offer explanations of why such a course was advisable. They were all very good-natured, and the interview afforded us a great amount of fun; but it ended by our feeling constrained to pay out the money, which will, no doubt, be refunded by the railway company responsible for the mistake.

In our subsequent rambles through Belgium, Germany and France we had no more misadventures, although we saw many things that appeared to violate the proprieties of railroading which we regarded as correct. Everywhere we met with the greatest kindness. Among the engineering establishments of note that we visited were the famous Krupp Steel Works at Essen. Here we were accorded the high privilege of going through the gun manufacturing part of the establishment, which is not generally shown to visitors. I shall give particulars of our visit to these works in a future letter.

Train running is not done with the rush and circumstance of hurry on the Continent that characterizes it in Great Britain. The express trains which we happened to travel with seldom exceeded a speed of forty miles an hour, and the average speed, including stops, was about twenty-five miles an hour. The cars on most lines are of the small compartment type, similar to what prevails in England, and very few of them have lavatory or water-closet accommodation, although the journeys made are sometimes quite long. The wide base rail universal with American roads is very generally used on Continental railroads, and metallic ties are very common. On some of the roads the fastenings of the ties seemed to be defective, for they rattled badly under the wheels. The condition of the track on most American railroads compares very favorably with that generally passed over on the Continent. Nearly all the railways we passed over had a fairly good system of signal protection for trains, and all the trains had continuous brakes. On some lines a lever was provided inside the car by which a passenger could apply the air brake, and a printed notice beside the lever informed the passenger of the dire penalties he would incur by applying the brakes without good and sufficient cause. A sealed wire attached to the lever acted as a tell-tale to indicate in which compartment the brake was applied.

The most forcible impression given by the locomotives on Continental lines is that no attention is bestowed on making the machine look well. The smoke-stacks inserted on the front end of by-gone American locomotives did not make a thing of beauty and a joy for ever, but an honest smoke-stack formed on the lines of an inverted hay rick was a pleasing sight compared with the angular sand-boxes, deformed drums and distorted attachments that are pushed prominently to view on many Continental locomotives. The engines mostly have outside cylinders and valve gearing of various kinds outside the wheels.

We saw a good deal of the working of the Prussian railways and were by no means enamored, although vastly amused with the military system of operating. The tyranny of forms is everywhere apparent and the superfluity of red tape is not calculated to accelerate the movement of trains. I noted at one junction point a few of the motions made in getting a train backed up to the platform and started. A most imposing uniformed individual conspicuous above the others by having a red cap raised his hand and shouted. Another uniformed man with a sombre cap gave a signal to the guard of the train. That official tooted a horn and waved to the engine driver, who whistled twice and backed into the station. The passengers took their seats and the luggage was loaded, and then two strokes were given to a bell in the station. Great commotion ensued but the uniformed officials appeared quite collected. The red-capped official raised his hand and one stroke of the bell announced increased progress in the preparation for starting. Then the guard tooted his horn, the engine driver tooted his whistle and the train moved off with the utmost deliberation. Traveling on the Continent is a delightful pastime, but it is not of the kind that suits men who are impatient to get through the world in a hurry.

A. S.

The Pullman Palace Car Company's annual report shows a total gross income from sales of manufactured products during the year of $8,652,746. Besides this the company received $1,735,417 for rentals at Pullman. The works at Pullman built during the year 141 sleeping, dining, parlor and special cars, costing $2,511,596, an average of $17,813. The average number of names on the pay rolls at Pullman was 4,541. The wages paid amounted to $2,629,531, an average for each person employed of $579.06, against $604 during the previous year.

The total number of persons in the employ of the company is 11,063. Wages paid during the year amounted to $5,770,345. There are 1,760 standard cars and 239 tourist or second-class cars now in the Pullman service. During the year the total car mileage was 144,842,618, and the total number of persons carried was 4,242,542. The total extent of railways on which Pullman cars are now run by contract with the railway companies is 117,854 miles, an increase of 11,723 miles over the preceding year.

All doubt as to the intention of the Chinese Government to proceed with the construction of railways has been set at rest by the publication of an Imperial decree sanctioning the construction of a line from Pekin to Hoihow. It is to be commenced at both ends, Li Hung Chang being entrusted with the north part and Chang Chi Tung with the southern part. "The sovereign is of the opinion," says the edict, "that, to make a country powerful, railways are essential." The chief cause of this great revolution in the policy of the Chinese Empire is said to be a growing dread of invasion. The line is to be built in sections, and the money for it will be raised in small loans as the work progresses.

Western Railway Club.

At the October meeting of this club, D. L. Barnes read a paper on Compound Locomotives. After referring to what he considered false impressions in regard to compounding, which he claimed had been so proven by investigators, the author continued:

The simple reasoning which leads to a belief in the economy of using a high and a low pressure cylinder without a condenser is as follows:

We all know that in any simple engine with one cylinder, it is more economical to cut off steam at one-quarter than at one-half stroke, also that it is more economical to cut off at one quarter than at one-eighth stroke. We know this, because—using the most conclusive reason—by actual trial we have found it to be so. By actual trial, then, we well know that there is, in any cylinder, a point at which if the entering steam is cut off the greatest economy will result. * * * We also know beyond dispute that the total work which ought to be obtained from the steam used can only be secured by an increase in the amount of the expansion of that steam.

Hence, we find ourselves in this predicament; to obtain the greatest amount of work from a given amount of steam, it is necessary to cut off at the earliest point in the stroke which will assure just sufficient pressure at the end of the stroke to blow the fires. But—and therein the difficulty lies—we have found by experiment that to cut off at such an early point results in a loss from various causes. These causes have large names, and owing to the dispute existing regarding which one of the causes, or sets of causes, is the chief source of the evil, it is best to neither name nor consider them in a simple discussion of the subject. It is enough for all practical purposes connected with the locomotive for us to know that the most economical cut-off in locomotive cylinders is not the one which will result in the reduction of the steam pressure at the end of the stroke to about the atmospheric pressure or anywhere near it.

It is the compound locomotive that is at present offering a solution of the problem, and a means of harmonizing the conflicting conditions. With it the steam can be expanded to that pressure which will just blow the fires without using in either cylinder a cut-off that departs from the economical point to such a considerable amount as it would in the case of the simple engine. For instance, let us suppose that the one-quarter cut-off is found to be the most economical, then during the most economical operation of one cylinder the steam will be expanded four times before being exhausted. If two cylinders be used, it will be expanded four times in the first and four times in the last, or in both eight times. The terminal pressure will then approach nearer to that desired without having in either cylinder reduced the cut-off much below the most economical point. * * *

The principal advantage resulting from an arrangement of two locomotive cylinders in series, one after the other using the same steam, is, as has just been stated, the possibility of expanding to a more advantageous degree without departing materially from the most economical cut-off in the cylinder. But there are other advantages resulting simply from the use of two cylinders.

The use of two cylinders permits the cut-off to be longer in either where the speed is high and but little work per revolution is required. The longer cut-off for the same work results in the use of the ordinary link motion at a point where its action is more satisfactory. Moreover, the compression is much reduced. The back pressure in the low-pressure cylinder is more nearly under the control of the designer of the locomotive, and exists more as the result of the use of the exhaust to blow the fires than because of the cramping of the port opening through which the exhaust must pass to reach the nozzles. A favorite way of running compound locomotives at high speeds has been to place the low-pressure valve motion in full gear and cut off as desired in the high-pressure cylinder. While this is not a method that would be considered scientific from a purely mathematical standpoint, yet it has some advantages, not the least of which is reduction of the amount of compression and back pressure in the low-pressure cylinder, and a tendency to offset some of the bad features of the Stephenson and other link motions when the engine is revolving rapidly.

Two indicator cards illustrated herewith, one of which is taken from a compound, the other from an ordinary locomotive, may render this point clearer. Fig. 1 shows a card taken from a compound locomotive at a speed of 50 miles per hour with a high-pressure cut off of 50 per cent. and low-pressure cut-off of 73 per cent. Fig. 2 shows an indicator card taken from an ordinary locomotive at 50 miles per hour at a cut-off of 25 per cent. It will be noticed that the steam line in Fig. No. 1 from the compound locomotive is much superior to that on Fig. No. 2 from the ordinary locomotive. The card is fuller, showing a better valve opening, and the expansion line is more pronounced. The back pressure is less in the case of the compound, but as these cards were taken from different locomotives they are not comparable in this respect because different amounts of back pressure may have been needed to blow the fires in the different engines, yet the difference shown is about what we may expect between the indicator cards taken from the same engine before and after compounding, no other changes being made in its design. The most gratifying difference between these indicator cards lies in the compression line. In Fig. 2 the valve commences to close the exhaust ports about

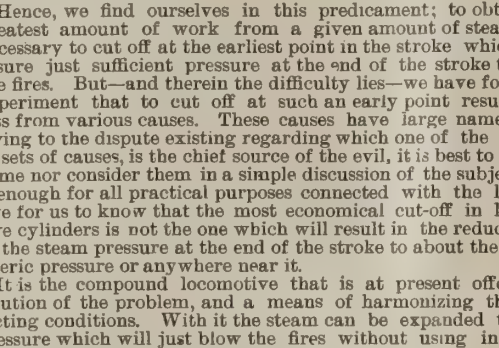


Fig. 1

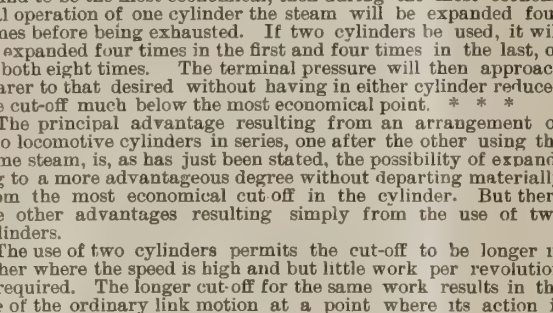


Fig. 2

midway on return stroke, and the resulting compression cuts off a large corner of the card, while in the case of Fig. 1 from the compound engine, the exhaust port closes suddenly, almost at the end of the return stroke, and the position of the compression line reduces but little the total area of the card. Fig. No. 1 also illustrates the results of the favorite method of running compound engines at high speed by dropping the reverse lever of the low-pressure cylinder until the cut-off is nearly at the maximum. This condition places the valve gear in the best position for promoting the exit of the exhaust from the cylinders, and removes to a considerable extent one of the worst defects of the ordinary type of engine.

Another advantage, and one of the most practical, resulting from the use of two cylinders in series on a locomotive, is the increased efficiency of the boiler as a result of a decrease in demand upon it for steam. This is brought about by the fact that the steam extracted from the boiler for a compound engine is used to better advantage, and each one pound of it does more work than each one pound in the case of the common locomotive. Therefore, for the same train load less steam is used and less demand is made upon a boiler. This is no small advantage, as can be seen when one remembers how hard our locomotive boilers are crowded in proportion to the boilers used in stationary service.

We have now seen what are the three principal improvements which we hope to make by the use of two cylinders connected so that the steam of one enters the other instead of being discharged to the atmosphere. These improvements, as before stated, are, when simply expressed:

1. More economical use of the steam taken from the boiler, because of greater expansion.

2. Use of the steam to greater advantage, for the reason that the link motion is operated under more favorable conditions.

3. A decreased demand upon the boilers now in use, which, we all believe, will result in an increase of economy in the consumption of fuel.

The question now naturally arises, "To which of these three advantages does the compound locomotive principally owe its usefulness?" Only one answer can be given: "We do not know." It is the combined effect of them all, and experiments have been made which show wherein the greatest increase in economy. * * * Therefore, being thus in doubt regarding the cause of the increased economy, it would be advisable for those who are contemplating the trial of compound locomotives, while perhaps not avoiding the study of the mathematical, or what might be called the theoretical, side of the subject, yet to incline rather to the more practical and tangible side, and proceed to make all deductions from the actual indicator cards taken from the present engines, and endeavor as much as possible to remove, while making the new designs, the three great evils of high-speed locomotive cylinders and valve gear, viz.: The enormous compression, the high pressure and the marked wire-drawing of the entering steam.

Other advantages than those mentioned here will present themselves to you as a result of the decrease of the demand for steam from the locomotive boiler in its regular work, not the least of which is the reduction of one of the greatest evils in locomotive boilers as now constructed and operated viz., the large amount of water accompanying and suspended in the steam furnished the cylinders. All of the water which enters a locomotive boiler is not necessarily evaporated into steam. In some cases as much as 50 per cent. can go over to the cylinders in the form of water as a result of a much forced draft and a contracted steam space above the water in the boiler.

In speaking of the ratio of cylinders, Mr. Barnes said:

Various ratios of one cylinder to the other have been tried, varying from 2 to 1 to 3 to 1. A short conclusion drawn from the results of the trials may be stated, without departing from the truth, as follows:

First.—The capacity of the high-pressure cylinder compared with the low-pressure cylinder should depend upon the character of the service for which the locomotive is intended.

Second.—In general, unless the low-pressure cylinder is greater than twice that of the high-pressure cylinder, changes will be demanded in the valve motion in order to gain the maximum economy and greatest efficiency.

Third.—If two reverse levers are used, thus rendering the cut-offs in each cylinder independent of the other, then the action of the locomotive in hauling trains, particularly at high speed, will not be unsatisfactory, even when the cylinder ratios are not such as to allow the maximum economy in service.

In discussing Mr. Barnes' paper Mr. Crossman thought the matter should be left open so that Mr. Hughes, of the Northern Railroads of India, would be able to present a paper.

Mr. Gibbs thought that with two reverse levers there would be unequal working.

Mr. Barnes said that was possible, but there would be the same danger if only one lever were used.

Mr. Rhodes would like to know what was the minimum pressure at which it was advisable to compound locomotives.

Mr. Barnes answered at from 80 to 90 lbs.

Mr. Gibbs thought the compression in the simple cylinder locomotive an advantage. He said:

Can we design a compound locomotive of such dimensions of cylinder as will allow us to start and get under way a heavy train under our American practice, and after we have worked that train into speed, working on a level, will we not have to cut off too short to realize any economy from compounding? It is well established in compounding pumping engines, if you start in at low pressure, less than a certain pressure, which is about 50 pounds, you realize no advantage from compounding. In a locomotive, where we have to cut off so short, or wire-drawn steam, how can we get economical pressure in a low-pressure engine? It seems to me that is a serious difficulty, and that it is the principal stumbling block in the way of compounding.

Mr. Barnes thought that in a slow moving engine this might be the case, but thought it would not be in the instance of an engine, like a locomotive, worked with the Stevenson link. The steam was wire-drawn and so superheated. With superheated steam experiments had shown that the steam could be cut off as early as 8 per cent. with economy.

Mr. Gibbs inquired about the riding of a compound engine; whether it rode as smoothly as a simple cylinder engine.

Mr. Barnes had heard no complaints in this respect.

The president inquired about the relative wear of tire. Mr. Barnes could not inform him, but thought the wear of tire would be greater in the compound.

Mr. Gibbs thought the advantage in the wear of tire should be in favor of the compound, in that the effort of the crank gear was more uniform, and Mr. Barnes thought his point was well taken.

The president said:

When the subject of discussing compound locomotives was brought to my notice, it occurred to me that it would be a good idea to write to Mr. Ely, of the Pennsylvania, and I did so, asking if he had any information on the subject to give us, and he writes, under date of Oct. 9: "We have had no experience with compound locomotives, with the exception of one three-cylindered compound locomotive, built for us in England. So far as we have used this locomotive there is an apparent economy in the fuel, but our trials have not yet been completed, and any information we could now give would not be very reliable. I see no reason why a properly constructed compound locomotive would not be economical in service."

It was concluded to continue the discussion in view of some information likely to come hereafter.

METAL FOR BRAKE SHOES.

W. D. Sargent presented a paper on the above named subject. Brake shoes, he said, should be uniform in structure, and of such quality as should not be tempered by the heat generated by friction. The same air pressure throughout a train on which shoes of different degrees of hardness were used would cause widely different degrees of friction on the wheels. The combination of a cast and wrought iron shoe is much more durable than the plai shoe. These shoes must, however, be well made, preferably using merchant bar iron sheared in dovetail pieces. On steel-tired driving wheels the Ross form of shoe was very extensively used; it is made of cast iron, with crucible steel pieces imbedded. The prime requisites in this kind of shoe were that the tire wear produced by the shoe keeps pace with the wear caused by the rail. The suburban passenger engine, making frequent stops, should be equipped with shoes less hard than those applied on a through passenger engine. The combination of cast iron and steel shoe has the advantage that the proportion of each metal may be varied to suit the requirements of the service.

Brake shoes for steel tired coach wheels were applied under entirely different conditions. Experiments had proved that a brake beam hung rigidly from the truck, in combination with the flange brake shoes, formed a grinding machine capable of turning a V-shaped flange, and that even with the plain shoe lateral motion was of decided advantage in protecting the flange. It could not be learned that any device had been used purposely to effect that lateral motion with the exception of the one the Pullman Company was now trying, consisting of a universal joint hanger constructed in a simple manner, although many brake beams do have some lateral swing.

The subject of friction developed, durability and other features of the different kinds of shoes were being investigated by several members of the club, whose tests, it was hoped, would do much to throw light on this matter, and to establish standards for the different conditions under which brake shoes are applied.

Discussing this paper Mr. Schroyer said he had made some tests of the different metals they had been using. As far as he had gone he had come to the conclusion that he did not know much about it.

Mr. Rhodes was glad to hear that Mr. Schroyer realized the importance of the subject. The brake companies had not given the attention they should have given to the brake shoe, and as a result when it was desired to see how quickly a train could be stopped the fault was put on the shoes. He said:

When we talk about the importance of getting quick-action brakes, and making short stops, the question is, have we given our brake shoes the attention that Mr. Schroyer says he is giving his? Here are some shoes (indicating pictures in M. B. C. report referred to) where the shoes barely got in service at all, and where they did rub; it is a hard white metal that produced very little friction—so the companies claimed. Here is another case where the shoes were made of soft gray cast iron. It is wheel metal, not the ordinary cast iron from which castings for cars are made. These have a black bearing. They had a full bearing. I think if we investigate the matter a little at the present day and look at the thousands of cars that are being made throughout the country, we shall find that they are putting in a shoe that the brake companies did not want at our brake test. What I think unfortunate in this shoe question is, that we have made no sufficient tests. First, we must consider the wear and then the friction that the shoe will give in making the stop. That subject has been named by the Master Car-Builders, to be reported on at the next annual meeting, and I hope that we shall get a great deal more information on the subject of brake shoes than we have heretofore had; and the first point for us to consider is how shall we make these tests in order to get this information? Would it not be a good plan to make the tests a little public, publish what the tests are going to be, and invite men who are interested in the shoe question to criticise these proposed tests, so that points may not be neglected which it is desirable to bring out. On the C., B. & Q. road we are much interested in this matter, too, and do not feel that we have given this subject so much attention as we might have given it.

Mr. A. J. Sargent had been in the brake business for fourteen years, but was unable to say what was the best metal for shoes. They made the best shoe for one road but it was not a good shoe for another road. They tried to make their shoes uniform, and kept a record of the mixture so they could duplicate it.

Mr. Gibbs would like to ask Mr. Sargent a little about his theory of the compound brake shoe.

Mr. Sargent said they had been using the Meehan T. The steel was about one-third the face, but could be varied.

Mr Verbryck said they had been using the Congdon shoe on their freight. This was a cast-iron shoe with pieces dovetailed in. On their steel-tired wheels they had used the Meehan shoe. He was satisfied that the composite shoe would outwear, three or four times, the plain shoe.

Mr. Schroyer then detailed some experience with different shoes. At present they were using nothing but plain cast iron shoes. When they found a slid wheel they found a soft shoe. He detailed some experiments, but said they had not gone far enough with them to make them conclusive.

Mr. Cook said they had been using the Congdon shoe, and had made some tests that satisfied them that it was the best.

Mr. Gibbs and Mr. Schroyer both spoke again, what they said showing interest in the subject.

Mr. Rhodes was anxious that the advocates of different shoes should make their claims known. He evinced a desire that the best shoe should come to the front.

The president called attention to the fact that Mr. Kidder, representing the Westinghouse air brake, was in the hall, and he would like to hear from him.

Mr. Kidder said:

I do not know that I can talk, because I have got a very severe cold; but in regard to the wear of the soft as compared with the hard brake shoes, I have had a little opportunity to observe something of the kind. A little over a year ago we equipped a couple of trains with soft brake shoes, and these trains ran for some months and gave most satisfactory results; but finally there was a complaint put in on the part of the engineers that the brakes didn't seem to hold as well as formerly. I investigated as well as I could, and found that it was the same as when we originally equipped the train, but on looking into the matter a little more thoroughly, we found that they had been gradually substituting cast-iron in place of the soft shoe, and they had gradually put these shoes on, and, as a consequence, the braking power had deteriorated.

Mr. Little said:

If you will allow I will read a report to show what a compound shoe will do without mentioning the road:

Total number of shoes used from Aug. 1 to July 31, 3,761; total number of cars in daily service, 380; total number of shoes used per car, 10. The average life for each shoe, 290 days. I am very glad to have Mr. Schroyer bring up the subject as he has. In going about the country I have found gentlemen not very anxious about looking up brake shoes. They simply say when a brake shoe is worn out we put on another; but I am very glad that Mr. Schroyer and Mr. Rhodes are going into these tests, because it will help us as much as any one else, and probably more than it will the railroads. We have never had a cut tire. No kind of tire we have put our shoes on has ever been cut that we know of. I find by questioning the engineers that they get just as much friction as they need, and have no complaint to make in regard to loss of braking power.

The New England Railroad Club.

The subject for discussion at the regular meeting of this club was: "Permanent Way and Rolling Stock, and Their Relation to Each Other." In the discussion Mr. Lauder thought it would be profitable to look back twenty years and trace the improvement. He thought the rolling stock had been improved as much as the permanent way since the time when they had iron rails, and no fish bars. Twenty-five years ago an engine of 30 tons was considered heavy. He was connected with a road that built engines of 30-ton weight, and then sold them because they were too heavy. He wanted to say a word in regard to the influence that clubs and associations had exerted in bringing about a better state of affairs in railroad matters. Twenty-five years ago every railroad was a law unto itself; every man in charge of rolling stock got up his own designs, and carried out his own notions—perhaps got a good many of his cranky notions into his rolling stock, gauged his wheels to suit his ideas, the lateral motion varying from ⅛ to ⅝ of an inch. The associations have created a great change.

Mr. Lauder then reviewed the work of the Master Mechanics' Association and the Master Car-Builders in establishing standards, and said:

The roadmasters have an organization four or five years old, and have done good work as far as they have gone, and I hope they will make their organization as much of a power in their profession as the Master Car-Builders' have in theirs. There is no question that the reports brought out at their conventions will lead to greater uniformity in the construction and maintenance of the permanent way. * * * I find there is a great diversity of opinion as to the proper section of rail. * * * We rolling-stock men have designed and put in force a certain section of wheel tread and a certain section of flange; we have arrived at that after years of observation, and we find that it is correct, and that is the best possible shape for the tread of the wheel. It has become well established, and I don't think anybody proposes to make a change in that. I think it is incumbent upon the engineers and roadmasters to settle on a standard railhead, and after years of observation and experiment it seems to me that we are far enough advanced to-day to have a section of rail designed for these different weights that shall be a standard for the whole country. Of course, there will be the same trouble in arriving at a standard as there has been in getting standards for our rolling stock, arising from differences of opinion and the belief of each designer that his is the best form. I think it took the Master Car Builders five years of constant labor and effort to adopt the standard axle, but it has proved a great benefit, notwithstanding its defects. I believe the same benefits would result from the adoption of a standard rail section. The Master Mechanics have adopted recently standard driving-wheel centers, which are being rapidly adopted by the different roads, though at first they were greatly opposed by many of them; so that in a few years it will be possible for any tire maker to pile up thousands of tires in his yard, knowing he can sell them, because they are standards, and fill his orders promptly. You can buy thousands of standard axles that can be shipped within twenty-four hours. If there were at the same time a standard section of rails of different weights, it would enable the rail manufacturers in dull times to make them and pile them up, and be ready to fill orders at short notice; and this would also be a great advantage to the railroads, because they would make the manufacturers carry the stock instead of carrying it themselves, as they are now doing with the tires. Now at times a road which cannot wait to have rails manufactured to order will, in case of emergency, take a rail slightly different from its standard; those rails will get mixed with others, and the fish bars will not fit, and trouble ensues. The very essence of any road is to have a well-fitting fish-bar. Although it is not in my department, I am interested in having a good track, good switches, good frogs, and everything good that pertains to the track, because my rolling stock will stand up and work longer and with less repairs than on a rough track.

Mr. Ellis, being introduced by the president, spoke at considerable length. The rail, he said, should never be less than 72 pounds per yard, and as much heavier as could be secured. Rails should be curved before laying on any curve that exceeds two degrees with some form of machine that should not produce sudden concussion. The split switch with automatic stand with flexible switch rod, should be used not only on the main track, but in the renewal of side tracks subject to any considerable service. He also recommended the use of a guard at the point of all split switches, not trailing switches, and the use of a spring rail frog in all cases where it was desirable. He argued at length the utility of the suggestions he made in relation to permanent way, tread of wheels, etc., and inquired if there was a brake shoe that would keep the tires in good condition.

Mr. Lauder said:

Mr. Ellis asks if there is a brake shoe that will keep the tires in comparatively good condition, as they are worn away by the rail? There is a brake shoe, called the Ross shoe, which has a bearing on the flange and on the outer side of the thread of the tire, and has another bearing on the part of the tire which usually comes in contact with the rail. I believe that no engine should be run without a driver brake; and if it is equipped with a driver brake which is used as it should be, the Ross shoe will keep the tire in very much better shape to meet the requirements of a well-fitting tire to the rail, than if it is allowed to run without a brake shoe.

Mr. Lauder also believed that it would be a good economy for all railroads to turn their tires much oftener than they did.

Mr. Bishop said: I consider it very important to harmonize the track with the running of the trains. There are many things to be considered in this matter, one of which is the speed at which the trains pass over the track, With a high rate of speed the tendency is for the wheel to press more closely to the outer edge, consequently the rear of the flange, passing over the inside rail, will come in contact with the wing of the frog and cause a sudden jerking with a heavy train running at 50 or 60 miles an hour. Then a train passes over the track at a speed of 30 miles an hour, and perhaps the engineer will not experience any jerking sensation in going through the frog. The engineer running at 60 miles an hour will report some trouble with the frog, and then comes a freight train which is limited to 12 or 15 miles an hour, and that sags over to the inside rail, and then there is another difficulty. There are many things to be taken into account after we have got the standard rail and the standard car. I think the time is coming when the track department will receive more attention, and be considered of the first importance in railroading.

Mr. Clark exhibited a piece of rail taken from near a switch, and claimed that the tire that would wear the rail into that condition was not fit to be used. He believed that the split switch at the point should not be so much damaged as to require to be taken out under three years.

Mr. Whitney, of the Intercolonial road:

It is very rarely the case with us that we have a tire worn down so that you can call it a double-flange tire. We don't allow them to run so long; we have occasionally let them, and had broken crank-pins and broken switches. I think it is good economy, not only for the track, but for the rolling stock, to keep the tires in good order. It costs something, to be sure, not only to do the work, but in the loss of the engines for the time—a considerable item if the road is busy. We never let an engine run to the extent that it is indicated they are here on some roads. I think it is important to have the shape of the rail and the wheel to conform as far as possible.

Professor Swain said there was difference in opinion as to whether or not the rail should fit the wheel. He was sorry to see six-wheel trucks supplied with four-wheel brakes. There should be a brake on every wheel.

The Time Convention.

The fall meeting of the General Time Convention was held at the Hotel Brunswick, New York City, on Wednesday, Oct. 9, President H. S. Haines (Savannah, Florida & Western) in the chair. Sixty roads were represented by about 70 delegates.

Nov. 10 was agreed upon as the date for the fall change of time. The Executive Committee reported the membership to be 176 companies, representing 120,891 miles of road.

On committees to be hereafter appointed, a name of a railroad company will be designated for each membership on the committee, the managing officer of the transportation department to be the individual member of the committee unless he shall designate some subordinate official of his company to serve. The Committee on Car Service was made a permanent committee, to consist of nine members, to serve for three years, three members to be elected each year. The present membership of this committee is as follows: New York Central & Hudson River; Lake Shore & Michigan Southern; Pennsylvania; East Tennessee, Virginia & Georgia; New York & New England; Chicago, Burlington & Northern; Chicago, Rock Island & Pacific; Missouri Pacific; Northern Pacific.

The sale of copies of the Proceedings of the Convention to all parties not members thereof at $1 per copy was authorized.

It was decided to appoint a committee to be known as the "Committee on Safety Appliances," to consider what are the essential requisites in all devices for power brakes, automatic couplers, interlocking switches, block systems, and for heating and lighting cars, and what action should be taken by the convention with reference thereto. This committee as appointed will consist of representatives of the following-named roads:

Richmond, Fredericksburg & Potomac; Fitchburg; Delaware & Hudson Canal Company; Philadelphia, Wilmington & Baltimore; Chicago & Northwestern; Baltimore & Ohio (Trans-Ohio Division); Union Pacific; Southern Pacific Company (Pacific System); Louisville & Nashville.

The Committee on the Standard Code reported that 15 roads, operating 13,135 miles, have adopted the code in the last six months, and that 79 roads, operating 52,267 miles, are now operating under it.

The plan for the organization of car-service associations, and the forms to be used in conducting the work presented by the committee on that subject, was, with slight amendments, approved by the Convention. The date for the adoption of the mixed plan of settling for interchange car service, which had been fixed for Jan. 1, 1890, was also reconsidered, and the whole subject is to come up for further consideration at the next meeting (April, 1890).

The Superintendents' Association.

The eighteenth meeting of the Association of North American Railroad Superintendents was held at the Hotel Brunswick, New York City on Monday, Oct. 7. The meeting was called to order by the President, C. S. Gadsden (Charleston & Savannah). Some thirty members were present, and fourteen new members were elected.

The report of the Executive Committee was presented by the Chairman, President Gadsden, presenting the order of business for the meeting, and calling attention to certain financial recommendations. Prof. C. Herschel Koyl, of Easton, Pa., read an interesting paper on signaling, describing his parabolic semaphore, and illustrating by a working model of the device. The distinctive features of his improvement consist in the original method of illumination, by which the semaphore arm shows red, indicating danger, both by night and by day, when in a horizontal position, and white, indicating safety, both by night and by day, when in an inclined position, the effect produced rendering the signal visible at a much greater distance than an ordinary semaphore.

The Committee on Rooms and Headquarters reported that, in their opinion, it was not expedient to procure a permanent headquarters for the Association located at any one city or railroad center, believing that the best interests of the Association will not be served by having the meetings held permanently in one place, and that the members of the Association should become familiar with the practice of other lines than those on which they are engaged.

The Committee on Roadway, J. B. Morford, chairman, presented a long report, which was accepted, discussing rails, fastenings, spikes, metal ties and safety appliances. The 80-pound rail of the Michigan Central was recommended for roads of heavy traffic.

On the subject of guard rails on bridges the committee called attention to the pattern adopted on the Michigan Central, and exhibited blue prints of it. The Michigan Central form of guard consists essentially in three ordinary iron or steel rails placed longitudinally between the track rails at equal intervals. These extend straight out several feet beyond the bridge each way, and are beveled at the ends. The cross ties are only three inches apart, and the system is expected to guide derailed cars safely over a bridge, whatever position the trucks may be in.

The next business was the adoption of the new form of constitution proposed at the last meeting, and printed with the proceedings of that meeting. The principal changes are the following: The name of the association was changed to "The American Society of Railroad Superintendents." The scope of membership was enlarged so as to include, in addition to the active members, honorary members, associate members and delegate members. The principal officers of the Association were made to hold their office two years, and the Executive Committee was enlarged. Some changes were also made in the duties of officers, and annual dues or other assessments are hereafter to be collected by the secretary. The duties of the Executive Committee were defined, and the regular meetings of the Association were made annual instead of semi-annual, to be held in the fall of the year, the present officers holding over until the next regular meeting in the fall of 1890.

A paper was presented by L. W. Palmer, Superintendent of the Providence division of the New York & New England, on the subject of terminal charges. Mr. Palmer pointed out the inequitable features of the system in vogue of dividing revenue on a mileage basis, and called attention to the growing importance of allowing originating and delivering roads a terminal charge on through shipments over three or more roads before prorating, because of the increasing cost of terminal grounds and the prospective system of paying for foreign cars by the day. Collecting a sum from consignees for detention of cars does not reimburse terminal roads for track room and switching expenses, for most of the freight is delivered within 48 hours and before the special charge against the consignee begins.

There was very little formal discussion at the meeting, except upon the new constitution. The annual assessment and membership fee was increased from $3 to $5. A committee was appointed to revise the by-laws and report to the next meeting.

Inside Finish of Cars.

The following paper was read on the above subject by Mr. Joseph J. Murphy, of the Louisville & Nashville at the last Master Car Painters' Convention: I will not insist upon all or any of you adopting this formula as the standard method of finishing the interior of your passenger cars, but as it is the one I have used for a number of years and met with good results, I give it for your consideration. In the first place we will suppose that the inside woodwork of the car under course of treatment is of ash or oak, and as ash or oak are the most porous or open-grained wood we have to deal with, if we can bring them up to a good and durable finish with varnish we will have no trouble in using the same method with the other species of wood of closer grain now used in car construction.

The first item on the list is what will make the best filler so as not to injure the natural beauty and color of the wood, and at the same time fill the pores thoroughly and permanently. For this filler I use corn starch mixed as follows: Five pounds corn starch wet with one-half gallon raw oil, three-eighths turpentine and one-eighth gallon japan gold size. This mixture is applied freely, brushing well into the pores of the wood, and will set ready for cleaning off in about one-half an hour after being applied. Clean carefully, leaving none of the filling upon the surface. After the filling is dry, and it should have at least ten hours to do so, sandpaper lightly and apply a thin coat of equal parts turpentine and rubbing varnish, using no shellac, as shellac has a tendency to color the wood; besides, the thinned varnish is easier applied and far better for the work. For this coat give one day to dry, then hair off and give a coat of clear rubbing varnish, not the grade known as inside rubbing, but the same kind of rubbing varnish as is used on outside of cars. This coat should stand for two days before sandpapering, and sandpaper as closely as possible without cutting through to the wood, then apply the second coat of rubbing varnish, which should also stand two days to dry, then hair off again and apply the last coat of rubbing varnish, which should stand as long as time will permit, or at least four days, before rubbing down with pumice stone and water. But before rubbing down with water the edges and all panels should be well painted with say two coats of oil paint to prevent the absorption of water while in process of rubbing down. This painting upon the back of the panels is important and should not be left undone. The painting can be very easily applied while the different coats of varnish are being put upon the surface of the panels. As to the rubbing, I will merely say that it should be done carefully so as not to cut through or remove the varnish upon the sharp edges of moldings or carvings, if any are used in the wood finish of the car. And after the work is rubbed down it should not be oiled, as is generally done, to give it a finer finish. I have used for some time a preparation that is far superior to oil, but as it is on the market for sale and my natural modesty forbids me upon this occasion from advertising any firm's goods, I will simply say that a small amount on a piece of rag or waste passed over the work leaves it with a beautiful polish and without that greasy look that oil gives. This final wiping, as I will call it, had better be done after the carpenters are all through with the trimming up of the car, and just before it is turned out of the shop for service.

The Pennsylvania Railroad Company has just ordered the erection of a large car repair and machine shop at Wall's Station, on the Pittsburgh branch. The principal building at the new repair shops will be a circular building, subdivided into eight circles. The outer circumference will be about 432 feet, the second, 236, and the third, or court, 100 feet. It will be built partly of bricks, stone and iron, and the building will be well lighted. There will be tracks leading into doorways every few feet apart. Besides the car repair shops, a number of other shops will be erected, among which are a machine shop 91 feet 2 inches by 51 feet 2 inches; a blacksmith shop, 102 feet by 60 feet; an oil, glass and paint shop, 83 feet by 10½ feet by 20 feet; a lumber shed, 128 feet by 50 feet; a planing mill, 125 feet by 70 feet, and a boiler shop, 30 feet by 40 feet. These works will give employment to over 1,000 men, and those who live in the vicinity of Wall's will get the preference. The work is to be completed by February.

Although the new standard axle of the Master Car Builders' Association has a collar, there is a strong liking for axles without collars, and it is certain that before long steps will be taken to introduce on two roads at least a standard collarless axle. One case has come to notice where, after long continued service, satisfactory results have been obtained from collarless axles used on trucks without end frames, and without special preparation for keeping them in rectangular form. One of the arguments advanced by those in favor of the use of collarless axles on the ordinary truck is that less trouble will be experienced from skew trucks if they have a certain degree of flexibility than if they are made rigid, and therefore when deflected laterally remain rigidly out of square.

Railway Car Construction.

BY WILLIAM VOSS.

Fourteenth Paper.

POWER BRAKES.

Under this head it is necessary only to consider the Westinghouse automatic air brake, as there is no other system in operation for freight service. The preference shown this brake is due to two causes: First, its successful operation during a long number of years on nearly every passenger train in this and a number of other countries, has established its practical value and reliability; second, it has no peer for quick and powerful action under all circumstances. At this late date it would be almost impossible to establish another system, even if this should possess equal or superior merit, as our extensive interchange of freight cars makes it imperative to have uniformity, and the fact that a very considerable number of cars have already been equipped with the Westinghouse would compel a prospective rival to so arrange his brake as to work in conjunction with this.

The apparatus required for a car consists of, first, a cylinder in which a piston, when actuated upon by the medium of compressed air, is set in motion, and which, through suitable connections, applies the brakes; second, a reservoir, in which the compressed air is stored, and which has sufficient capacity for several applications; third, a line of pipe, with couplings at each end, which pipe, when the car takes its place in the train, forms part of the main pipe conveying the compressed air from the main reservoir and pump located on the engine to the auxiliary reservoir under each car; fourth, a *triple valve*, or that part of the apparatus which gives the brake the (for want of a more appropriate name) so-called automatic feature. The functions of this valve, or rather combination of valves, which is operated by a (for this purpose) produced difference between the pressure in the main pipe and that in the auxiliary reservoirs, are many. In its perfected form it not only serves to admit air to the cylinder, allows it to escape and opens or closes communication of the train pipe with the reservoir, and all at the proper moment, applies the brakes when the train accidentally breaks in two or the pipes or couplings are ruptured, and compensates for any slight leakage without setting the brakes, but it also performs the duty of graduating the cylinder pressure, making it possible to apply the brakes with any desired degree of force to the extent of the maximum pressure carried; and when a quick application is desired it assists in producing the necessary reduction of pressure in the pipes, at the same time utilizing this otherwise wasted air for partially filling the cylinder.

In addition to the above principles the following minor parts are required to complete the equipment. The main pipe requiring to be closed where it terminates under the last car in the train makes it necessary to fit the several pieces making up the whole with a stop cock at each end, as any of them and either end may be the rear; the cocks are also useful when it is desired to part a train for the purpose of switching and not set the brakes. A stop cock is also placed in the branch connecting the main pipe with the triple valve. This is used only when some part of the apparatus fails to work or a member of the gear is broken; its closing does not affect the balance of the train. Each auxiliary reservoir is provided with a small valve by which the brakes can be released when they fail to do so by reason of the pressure in the reservoir being from some cause greater than that in the pipe. On long down grades the air in the auxiliary reservoir is liable to become exhausted from frequent applications. To make a recharging possible without releasing the brakes, the exhaust is on these occasions controlled by a weighted valve, acting by gravity and exerting a pressure of ten pounds per square inch which amount is retained in the cylinder until the foot of the grade is reached, when this valve must again be cut out and the exhaust port be opened to the atmosphere; a small cock immediately below the valve is provided for this purpose. This *pressure-retaining valve* is located at some convenient part of the car—preferably at the end immediately under the roof and near the hand brake—and is connected with the exhaust port of the triple valve by a small pipe.

The efficiency of the air-brake depends greatly on a proper proportioning and adjustment of the rods and levers. The exact amount of brake power to be exerted cannot be determined owing to the variable condition of the rails, the wheels being less apt to slide on a clean and dry rail than on one that is greasy. To be on the safe side, the pressure on the brake-shoes is usually only 75 per cent. of the light weight of the car—or, more correctly speaking, the pressure exerted on each wheel is equal to the above portion of load carried by it. Even then it is difficult to prevent the sliding of wheels when the condition of the rails is particularly bad, and extreme care must be exercised in applying the brakes to prevent this.

Several attempts have been made to automatically proportion the brake power to the load carried, but so far without any marked success; the problem is difficult, but should it be solved so as to be within practical limits, is certain to be adopted.

A proper adjustment of the connections and the elimination of lost motion as much as possible is important. The extreme travel of the piston is but 12 inches, of which 4 inches should be reserved for wear of shoes, etc.; the remainder, after being reduced by the required leverage to a fraction over 4 inches, has to be distributed between the four brake-beams, allowing but little more than 1 inch, or even less if the car is heavier and the leverage greater than the one under consideration. This shows the necessity of rigid connections and beams. The practice of utilizing the force of gravity of the beams and shoes by inclining the hangers will answer for hand-brakes for keeping the shoes off the wheels and the slack out of the rods, but this force is not sufficiently strong for the more numerous connections and limited travel of an air-brake. The application of release-springs to the beams would put any desired strain on the rods and also compensate for all slack in the pin connections; but so far these springs have not been introduced for freight equipment, although invariably used for passenger cars.

The unsupported wooden beams are also too flexible and unreliable, and when used for power-brakes are strengthened with an iron plate or a pair of truss-rods. The former are about ¼-inch thick, and are secured to the under side of the beam with ordinary wood-screws, and the latter are attached with cast-iron washer-plates and center-bearing, as shown in Fig. 100. The tendency of late, however, is to abandon the wooden beams altogether and substitute iron or steel beams, of which a number of excellent patterns are now produced.

Any of the systems of levers and rods used for double hand-brakes are suitable for air-brakes also; but those shown in Figs. 95 and 98, and reproduced on an enlarged scale, together with the necessary alterations, in Figs. 99 and 100, are principally used.

Referring to Fig. 99, the combined cylinder, reservoir and triple valve are bolted to blocks secured to the underside of the floor timbers with ⅝-inch lag screws, the blocks being just deep enough to allow the piston rod to pass under the needle-beam. The main pipe is located as shown. It is supported at the center by passing through openings cut in the cross-ties, at the transoms, by U-shaped hangers, and at the ends and one intermediate point by clamps or brackets, secured in their respective places by ½-inch lag screws. To prevent injurious bending of the hose connections, the pipe must terminate at the proper point, and the dummy couplings for holding the hose when not in use be in the right place. The approximately correct distances are marked in on the drawings.

The pressure on the piston is transmitted to the gear through a plunger or push rod, one end of which is guided by the hollow piston rod, and the other end is attached to the lever with the usual jaw and pin. The spacing of the holes in this lever depends on the weight of the car, the cylinder pressure and the proportions of the truck levers, which are usually not altered for cars of different weight. In this case the light weight of the car is taken at 24,000 pounds, which is probably the average for cars of 40,000 pounds capacity, and the maximum air pressure in the *cylinder* at 50 pounds. Seventy-five per cent. of this weight distributed over four brake beams brings 4,500 pounds on each, which a truck lever of 3 to 1 further reduces to 1,500 pounds. Multiplying this by 20, the long arm of the cylinder lever, and dividing the product by 2,500, the total pressure on an 8-inch piston gives 12, the length in inches of the short arm. The lever is extended 8 inches beyond the short arm proper to make the hand brake sufficiently powerful.

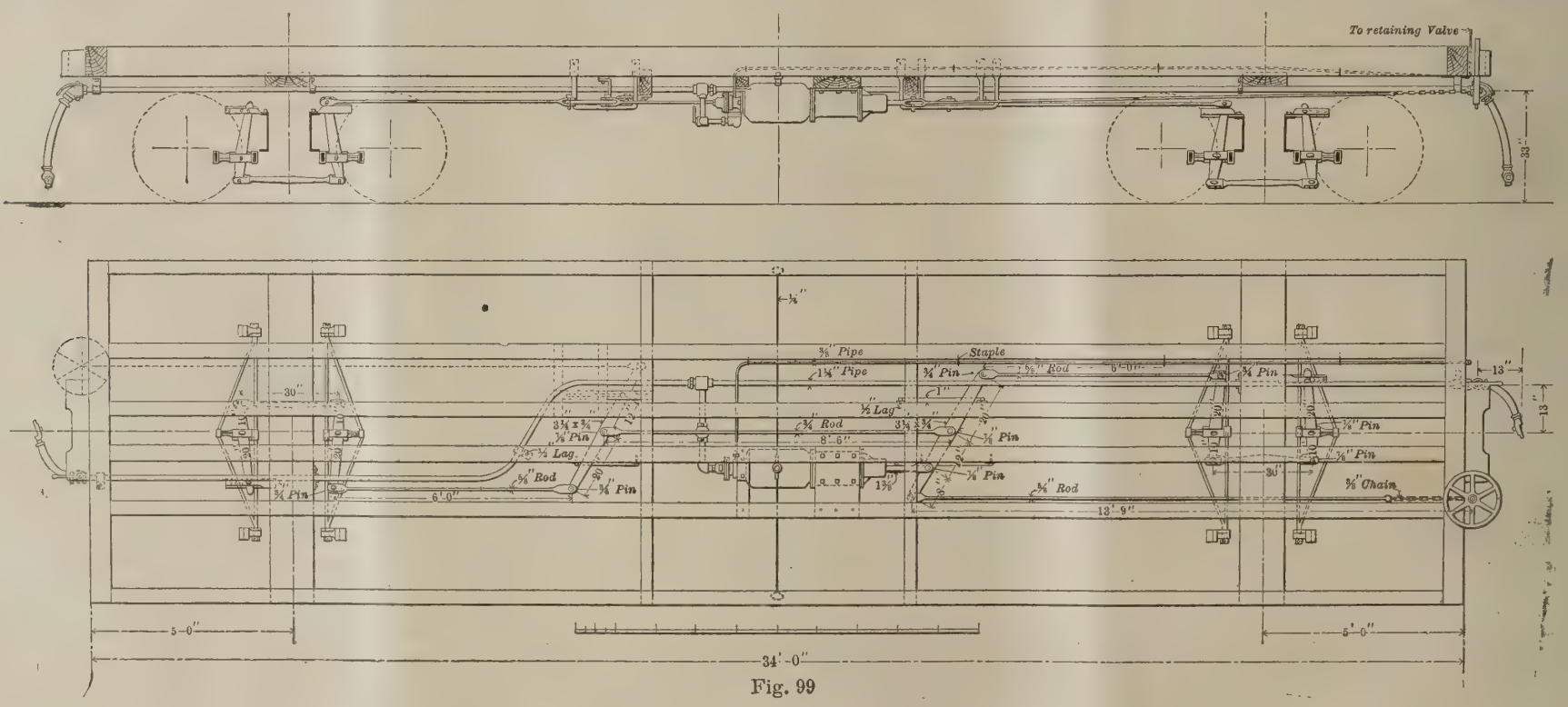


Fig. 99

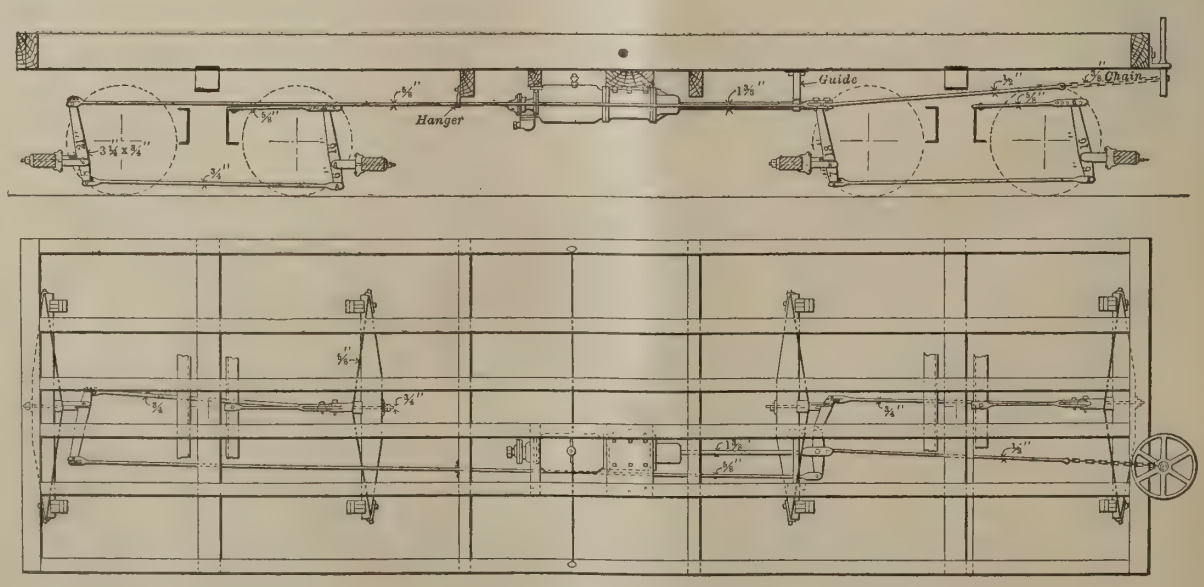


Fig. 100

The floating lever, which is connected to the cylinder lever by the equalizing rod, is of exactly the same proportions, excepting that the extension is omitted unless a hand wheel is desired at both ends of the car. In that case the bracket, which acts as a fulcrum, must be altered to allow this to shift when the brakes are set by hand from this end of the car. The alteration is indicated by dotted lines.

The levers are supported on carriers shaped from ⅞ or 1-inch round iron, which are secured to the sides of the center sills by ½-inch lag screws.

An air-brake gear also includes *dead* levers on the trucks. They serve the dual purpose of equalizing the pressure on the beams and affording a convenient means by which to take up the slack caused by the wear of the shoes or otherwise. They are of the same strength and proportions as the *live* levers, and are secured in any desired position by a guide fastened to the truck frame, a sufficient number of holes being provided in them to make all necessary changes. When the guides are properly proportioned there is no occasion to use any other means of adjusting the travel of the piston, such as turn-buckles in the lower connections.

When designing a brake gear, care should be taken to have all rods parallel to each other, thereby avoiding side and vertical strains as much as possible. The different parts should also be duplicates of each other whenever this is possible, so as to lessen the chances of having a broken gear repaired with pieces which are *about* the right length, which often occurs when incompetent help is employed. The truck levers usually are uniform for all classes of cars, but very little attention is given to the rods. There is no reason why the rods at one end of a car should be of a different length from those at the opposite end, and for cars differing in length, the same length push rod, lever rod, and also claim rod—if the distance from end-sill and bolster is equal—can be used, making a change in the length of the equalizing rod only.

A gear much used, because it is more simple and somewhat less expensive, is that shown in Fig. 100. In this example the beams are hung on the outside of the wheels, but the gear can also be arranged for inside connected brakes. The pressure is transmitted through a rather long push rod to the center of a short equalizer, one end of which engages by means of a hook forged on it with the live lever of the first truck, and a rod connects the other end with that of the second truck. Connection with the brake shaft is made by coupling the chain rod to the push rod, the jaw on which and for that purpose extends some distance beyond the equalizer. The push rod is supported by a guide of wrought-iron attached to the floor timbers; this and a small loop fastened to one of the needle beams to prevent the rather long connecting rod from sagging, are all the hangers this system requires. The truck levers, as will be readily understood from the drawing, must differ in length, but they are so proportioned that the pressure on all the beams is equal.

Train Accidents.

The various railroad companies throughout the country are making fairly good progress in the adoption of appliances intended to make the operating of trains free from accident; but, in spite of this, the destruction of life and property constantly going on from all kinds of accidents is terrible. When accidents happen many railroad companies exert themselves successfully to prevent the publication of any particulars, and, consequently, many accidents pass unrecorded; but, in spite of all this, the *Railroad Gazette* in its monthly record gives particulars of no less than 169 serious accidents having happened in the month of August. Business was not particularly crowded at that time, and the weather was good and daylight long. What may be expected when the roads are overwhelmed with business, the weather bad, and the daylight short?

Among the accidents are 81 collisions, 82 cases of derailment, and a number of miscellaneous casualties, among which were a broken side rod and a locomotive boiler explosion. Eight of the derailments were caused by broken axles, and several others were brought about by brake beams falling, which is an eloquent argument in favor of the use of stronger brake beams. The representatives of the Pennsylvania Railroad Company have at the Master Car Builders' conventions insisted on making it legal to use in the interchange of cars axles with very small journals. The effect of this policy is apparent in the accident list, for two of the axles that failed and sent trains into the ditch were on the Pennsylvania Railroad. A notable feature about the accidents was the small number caused through defects or failure of the machinery.

The great majority of the accidents are due to avoidable causes. The rear end collision, due to a train standing on the main line without being protected by flag, keeps up a prominent place. Closely related to this type of accident is that due to want of protection for trains at stations. One of the most fatal accidents of the month happened on the Rome, Watertown & Ogdensburg road and was caused by want of signals at a station. If justice were done, the president of that road, who is practically the owner, would have to answer in the courts for the death of the people who lost their lives through the absence of proper safety appliances.

Trainmen violating the important rules relating to the rights of trains continues to be a fertile source of accident and is inexcusable. There will be no real remedy for this till the men who fail to go out with a flag and those who risk running on another man's time begin to learn wisdom and common sense in the State prisons.

The Philadelphia & Reading keeps up a most unenviable record of train accidents. There are a great many decidedly un-American practices rampant on that road that are calculated to send good men away. It would be interesting to find out just what relation there was between the accidents and the character of the employés A most scandalous accident, resulting in the death of three passengers and the injury of 25 more, happened on the Pennsylvania Railroad through the spreading of the rails due to rotten ties. It is a sad commentary on the condition of the track on a road where the claim is so persistently made that the road-bed and all its appurtenances are the most perfect of anything to be found on this continent.

The record of train accidents during the month of August was not of a character unusually serious, yet 51 persons lost their lives, and 253 persons sustained personal injury. The figures are more eloquent than any words that can be used about them.

New Erie Ten-Wheel Locomotive.

The New York, Lake Erie & Western, with their growing passenger business, have had difficulty in getting their heavy fast passenger trains run over the mountain divisions on time. Various kinds of engines have been tried to do the work, and they are now likely to settle upon a heavy ten-wheel engine, one of which was built by the Baldwin Locomotive Works about six months ago as an experimental locomotive. That is, the railroad company ordered the engine, giving certain leading dimensions, with the intention of making the type a standard if she performed the work satisfactorily. Several more of the same kind have now been ordered, so the inference is that the railroad company have got what they want for the service. The writer recently rode on the trial engine from Jersey City to Port Jervis while she was pulling an express train, and he was very much pleased with the working of the machine, which represents the ideas of the Mr. Ross Kells, superintendent of motive power.

The engine is No. 319, and has cylinders 20 × 24 inches, with three pairs of coupled drivers 68 inches diameter. The boiler is 60 inches diameter at the smallest ring, and has a wagon-top fire-box, the mud ring being above the frames. This gives the engine a very high center of gravity, but she rides very steadily, and rounds the sharp curves with the long swing motion so well known with engines having a high center of gravity, and making such a pleasant contrast to those built with their boilers low down. The fire-box is 11 feet long, that great area being chosen for the economical consumption of anthracite coal. There are 284 two-inch tubes, which are 13 feet 2 inches long, and, with the fire-box, provide 2,095 square feet of heating surface.

The weight on the drivers is 96,700 pounds, and is distributed as follows: Main, 35,000; front, 29,200; rear, 32,500. The truck carries 29,000, making a total weight of 125,700 pounds, The tender is made to carry 3,600 gallons of water and 7 tons of coal. The boiler has an oval crown sheet, secured by radial stays. The grates are of cast iron, and made so that separate sections can be shaken. The smoke stack is of cast iron, of the Richmond & Danville pattern, 14¾ inches diameter, tapering downward and upward. The engine looks very handsome, and rides like a sleeping car. She doubles the division every day and is kept very regularly at work. A notable thing about the performance of the engine was that she ran up the heavy grades about as fast as she ran down, keeping up a very uniform speed throughout the trip. There is said to be no more expense for running repairs with this engine than there is with those having only four wheels connected.

A Modest Hero.

"Some men," remarked the doctor, "think that they can best distinguish themselves, when they become the chief officers of a railroad, by turning off as many as possible of the old hands. A superintendant wants new train dispatchers, new conductors and even new brakemen. A master mechanic has a following behind him, and to give his friends positions he turns out shop foremen, engineers and often firemen. I never found this practice to work well. The men familiar with the road and the ways of doing the work may always be depended upon to carry on the business for the interest of the company better than new men. I never saw this practice followed but it resulted in failure, and the men who make it their policy seldom remain long on one road.

"When I went on the M. S. as general superintendent I was told on all hands that I would find the worst set of men to be found on any road in the West, and that my first work ought to be the making of a clean sweep of the trainmen. The thing was repeated to me so often that I got to believe that I was going among a hard, incompetent crowd. I made up my mind to move slowly, but to be on the watch for black sheep.

There was on the road, as passenger engineer, a tall, lank, loose-boned Eastern man, named James McKinney, who had a gruff, independent way with him that I did not like. In a few weeks I made up my mind that I would start an exodus with McKinney. Time went on, and I had no decided cause for sending McKinney about his business, and a bad snow-storm came on. The main line got blocked near Chicago, and I had personally to take a hand in getting the track cleared. A number of snow-blocked trains had got together, and it was a terribly hard job getting the cars moved out. We toiled continuously, day and night, at the work, and the last night the only engine I had that could give help was that run by McKinney. We kept going all night long and worked steadily without a murmur, I had heard something during the night about the heater pipe on McKinney's engine bursting, but no delay was caused by it, although there was a fearfully cold wind blowing, and the bare prairie gave it full sweep, so that the men had good cause for giving in. Well, toward morning we got the line cleared, and when we were all done, McKinney asked some of us to help him to get down off the engine. I asked what the matter was, and he replied that his leg got burned when the heater pipe burst, and it was now so stiff that he could not move. We got him down and into a waiting room, and when we took his drawers off to examine the wound the skin of his side and leg came off. I was shocked, and asked whatever induced him to keep at work in that condition. In a matter of fact way he said that there was no one to take his place, and he could not let the work stop. He was laid up for six weeks, but got around again all right. I always found him just the kind of man that one would expect from the incident. His case was a lesson to me not to judge men rashly. He is now an engineer on the Union Pacific, and I know the company have no better man."

The Exhaust Torpedo.

The exhaust nozzle, with a so-called torpedo placed above the opening, to spread the exhaust steam, used extensively by Mr. Webb, of the London & Northwestern, which we illustrated two years ago, has been tried on a great many railroads in this country and in nearly every instance it displayed very good features; but we are not aware that the device is regularly in use anywhere on this continent It was not perfectly adapted to the exhaust pipes in use, but it appeared capable of being made very useful, and we are surprised that it has not been developed. Mr. W. Montgomery, of the New Jersey Central, speaking of this device, said:

In one instance we reduced the size of the stack and increased the nozzle with good results, by putting into practical operation the theory which was advanced by Mr. Webb, of placing a so-called torpedo, a sort of cone-shaped casting, near the base of the stack, with the idea of spreading the steam as it ascended from the exhaust pipe, producing a more perfect vacuum. Acting upon that idea, I made a new exhaust pipe, and cast the center down some distance and screwed into that a ¾ rod, and at the top of it screwed on the cone-shaped casting, so that the point of it entered into the nozzle, which was beveled out to throw the steam in such a form that it would strike the bottom of the stack, and produce a vacuum, or expel the air the whole length of the stack. Where we were running 16-inch engines with 3½, 3⅝ and 3¾ nozzles, we found that we got 4¼, or nearly equal to a 4½, nozzle by putting in this attachment. And the effect on the fire produced much better and more perfect combustion. Fewer sparks were thrown into the front end, and on the anthracite coal burners a more perfect fire was burnt. All over the fire-boxes the draught was steadier and lighter, and although we have made no experiments as to the evaporation of water or the amount of coal consumed, the engineers in every case have assured us that they found a decided advantage in the running of the engine with the increased nozzle, and that there was also a less consumption of coal. On some engines we found that the fire was burnt more in front of the fire-box or more in the back. This, with the old diamond stack, we could adjust by raising or lowering the petticoat pipe; but in this case the draught plates, if properly adjusted, regulated the draft, so that an equal amount of air was drawn in through the grates and properly and evenly distributed all over the fire.

With such testimony respecting its value, it appears strange to us that the torpedo and nozzle combination is not brought into general use.

Sometimes the services of a civil engineer are cheap at twice the money. An Iowa farmer and his hired help worked for a week digging a ditch to drain a bit of low meadow of his own into a railroad company's water tank reservoir. And when the ditch was opened the reservoir walked right bodily into the meadow and located about 20 acres of swamp where a good corn field used to be. And a mad man was the farmer, but he is now trying to find if the law will not compel the railroad company to remove its reservoir off his farm and pay for the crops destroyed.

It is proposed to shortly establish extensive works at St. Hyacinthe, Quebec, for manufacturing locomotives. The promoters are C. Roy & Co., a firm of iron and foundry men of Belgium. The City Council will give the firm a subsidy of $50,000 and a free site for the erection of th works, which will give employment to 400 men.

Communications.

Compound Locomotives.

Sydney, New South Wales, Sept. 3, 1889.

Editor National Car and Locomotive Builder:

I am much obliged for the kind and flattering manner in which you speak of me in an editorial in your issue of June, which I have just received. I do not wish, however, to be taken as asserting that compound locomotives generally must always be deficient in hauling power either at starting or when running up a heavy grade. While your quotations from "Recent Locomotives" are perfectly fair and accurate, they apply to compounds with cylinders which, in my opinion, are too small.

The hauling power of compound locomotives should be ample where the cylinders are of sufficient size, and, subject to this proviso, there should not be the slightest difficulty in starting a heavy train with the Worsdell compound. The Webb compound may possibly, under certain circumstances, have some difficulty in starting a heavy train, but in actual practice this combination of adverse circumstances would probably occur very rarely.

The power of the compound, like that of other engines, depends on the size of the cylinders, and the sizes at present used on the Worsdell and Von Borries type can be increased, if necessary. Some engineers believe that this increase would be advantageous. The designers think otherwise, and doubtless there are certain advantages on moderate gradients in having small cylinders. It is not surprising that on such a new departure as compounding locomotives there should be considerable diversity of opinion concerning the proportion of the cylinders, and no one can claim that the matter has been yet very definitely settled. I am, however, sanguine enough to hope that the many advantages of compounding will become so apparent that sufficient ingenuity will be called into play to overcome any grave defects which may exist at present, and that ere long we shall see compounds running which start as readily and exert as much or more power than ordinary non-compound locomotives, and are, moreover, far more economical in fuel. In this I think we agree, and probably you will, ere this reaches you, have further knowledge concerning the performance of compound locomotives in actual service.

I do not know if any results have been made public as to the hauling power of the Webb compound on the Pennsylvania, but I should certainly anticipate that she would haul a somewhat heavier train than engines having the same adhesion weight on the same number of coupled wheels, for the reasons that she would work with somewhat less friction and has somewhat less dead weight in the engine and tender. It is evident that this is an important point, for on the same run, the weight of the tender with coal and water must be in the proportion of the fuel and water used. Any reduction in the amount of coal burned means a corresponding reduction in the dead weight of the tender, while the smaller heating surface required means a smaller boiler. The weight thus saved can be applied to increasing the bearing surfaces, or the weight of the engine can be diminished. The total amount thus saved in the Webb engine and tender is, I believe, considerable enough to make a perceptible difference, especially on very heavy gradients.

Here, with our grades of 176 feet per mile, substituting one sleeper with six-wheeled trucks for one with four-wheeled trucks on our principal through trains, means running the trains as a double header! The importance of a few tons is, therefore, often considerable, and sometimes entails a great extra expense in running.

It is obvious that a saving in the expense for power is most important where power is a big item, and therefore we may expect that the compound principle rightly applied will be most valuable where power is most needed or where it is most expensive. An engine that can exert full power when working with a three-fold expansion must beat one working with a one and a third fold expansion. The ordinary locomotive with an 18-inch cut-off works with the latter, while a compound with the same cut off in the high-pressure cylinder works with a three-fold expansion. This, as I have often stated, is the main reason why the compound is the more economical. D. H. Neale.

Interchange of Cars.

Editor National Car and Locomotive Builder:

Sir: The questions asked by "J. E." in reference to interchange of cars in your October issue opens a very complicated matter which requires quite a little consideration.

In the first place, the fact that the Master Car Builders show a desire to have a joint inspection would indicate that the rules they have been making are defective, and cannot practically be used to advantage, or the inclination toward oint inspection would not exist.

Several years of practical experience have convinced me hat, although some of the rules are good, it is next to an impossibility to at all times live up to them. The greatest obstacle appears to be in the various constructions placed upon them by inspectors, and the ever-troublesome question of old defects. In a great many instances cars are rejected on account of old defects, which in no way endanger their safety, and which may run for years in the same condition without weakening any other portion of the car, simply because the book of rules gives inspectors the privilege of demanding a defect card to cover them. We will take, for instance, an individual case. An Illinois & St. Louis car loaded from Cincinnati to Boston. The inspector examines car before loading and discovers that it has one intermediate sill slightly cracked, but as the defect appears old he allows car to go. The car is loaded, and is forwarded to Cleveland, where it is offered to Lake Shore & Michigan Southern whose inspector also discovers this cracked sill, which, in his estimation, is perfectly safe, and he applies his pass mark, takes a record and allows the car to go forward. When offered to the New York Central, at Buffalo, their inspector takes the same view of the matter, applies his pass mark and allows car to go to Albany after taking a record of defect. Upon arrival of car at Albany the Boston & Albany inspector also discovers this defect, and although the Cleveland and Buffalo pass marks are applied, which indicate very plainly that car passed both inspectors in that condition, he asserts the prerogative given him by the book of rules (see Rule 4) and demands from the New York Central a card to cover the defect. What is the New York Central inspector to do? He can see plainly that the car has been running some time in that condition, but he either has to transfer the freight or apply a card as demanded.

He is aware that by having the freight transferred he is reducing the amount the car has earned for his company considerably, and he is also aware that by applying a card he is assuming some risk. We will suppose he applies a card and the Boston & Albany inspector allows the car to go forward, but on its journey some accident befalls it through negligence of the Boston & Albany company and it is sent to the shop for repairs. The sill for which the car is carded has to be removed and replaced by an entirely new sill. The card is also removed and rendered as a voucher against the New York Central for the cost of applying it. Is not this an injustice to the New York Central company? Now, I am of the opinion that had there been a joint inspector at Albany, a man of good, sound judgment, he would have taken into consideration the fact that this car had made the trip from Cincinnati to that point in that condition and was certainly capable of making the trip to Boston and return. It is such points as these that have raised the demand for joint inspection and make joint inspection necessary, which, I believe, would be very beneficial to all companies, if the proper men can be secured to fill the positions. F. D.

Car Couplers.

Editor National Car and Locomotive Builder:

I desire to suggest to you something relating to car couplers which has been to me and many like myself a real question, and one which is of vital interest, no matter what the coupler may be which will in the end become universal. While the evolution in the M. C. B. type is progressing, to adopt for repairs on old cars some coupler to be chosen by the men who do that work, and which they consider the most desirable, automatic, of course, and not expensive, and as much like an ordinary draw-bar as possible. The railroad companies would, of course, approve of such a course, as, instead of keeping hundreds of different kinds, a few in stock only would be necessary, and cars would not be delayed to find, or order, some coupler which had become obsolete, and which the world would be better off though it never had existed.

A superintendent of motive power told me not long ago that he was called on to pay a bill of twenty-four dollars for a broken draw-bar, when six ought to be the limit for a malleable iron one; and such things are and have been occurring daily for years, and cars are being held at a great loss to owners and shippers until some patentee can be discovered who has the exclusive control of said valuable article, and will allow it to be made and the broken car started again on its journey.

The adopted M. C. B. type could not be injured by this course.

As no road thinks for a moment of putting on the type on old cars, except where the repairs to the same are equivalent to rebuilding, and which being the case, this trouble must continue for many years; and the real fact is, that twice, if not ten times, more new cars are being equipped with common draw-bars than with the M. C. B. standard. Believe me, Truly yours,

A Train Man.

Improving the Train Service.

Editor National Car and Locomotive Builder:

I once heard a very successful railroad manager say, "There is no use in trying to regenerate an inferior set of trainmen by making rules; you have got to do it gradually by the selection of young stock." Low rates and general foolishness of the officers of competing railroads have kept down incomes so persistently that a great many railroad managers have been trying vigorously of late to obtain a margin of profit by reducing operating expenses. As usual the rolling stock departments are looked to as the parties to effect the saving. Everywhere we hear that extraordinary efforts are being made to reduce the supplies of coal, oil and waste, and one road of my acquaintance has stopped supplying waste and oil to the brakemen for packing purposes. They are given a bucket of prepared dope, and it is supposed that the stuff cannot conveniently be used for any ignoble purpose not provided for in the book of rules. Rules are rampant everywhere, instruction books are thicker than fallen leaves in November, but the old hands keep working on in the even tenor of their way, and I fail to see that they are at all stirred up by all the economical tumult.

I must confess that trying to do their work with the least possible expenditure of supplies does not cause much concern to the ordinary trainman. They have not been brought up to figure closely on the cost of their work, and few of them are disposed to trouble their heads about it now. This brings me to the opening of my letter and to the remarks of the railroad manager referred to. His head was level. The men who waste supplies as engineers begin work as firemen and the extravagant conductor begins work as a brakeman. On some Western roads, near me, where they are working the economy racket for all it is worth, I have good opportunities for watching the new men taken on as firemen and brakemen. Are the best men that can be found to accept the position chosen? Not much. The men are appointed through the favor of roundhouse foremen and trainmasters who have no sympathy with the call for a better class of men, and many of them are notorious for their unfitness for anything higher than using a shovel or pulling a coupling pin. Master mechanics and superintendents get up in their meetings and blow about the progress they are making in elevating their departments, while all the time their subordinates are left unmolested to stock the roads with trainmen whose proper place is on the track or shoveling on a dump. Till reforms begin at the foundation, all the talk of instructing trainmen to a better performance of their duties will end in disappointment.

John Little.

Interchange of Cars.

Editor National Car and Locomotive Builder:

Attached please find answers to nine questions asked in regard to the interchange of cars in October number, hoping you will consider them of sufficient merit to print in your next issue:

Question 1. To save controversy between foremen, inspectors, etc., often leading to unnecessary repairs, transfer or detention in some way to the interchange of cars. This is done by having a joint man that should be well posted, who is able to give an unbiased opinion, and whose aim and duty is clearly to do all in his power to advance the interests of all companies in which he is interested, and by moving this volume of freight as speedily as possible and requiring the delivering company to do such repairs as the M. C. B. rules advise and in his judgment is just to protect the receiving company from taking any car that is liable to cause delay, damage or accident, and to do this is to his own interests. Superintendents are liable to be more suspicious of men whose duty is not wholly occupied in their interests, so it behooves him to exert every precaution in the examination of cars to avoid anything that would have a tendency to show carelessness on the part of inspection. It should be the aim of every joint man to make a record of moving the largest number of cars with the least detention or accident.

Question 2. The joint man should have full charge of the men engaged in inspecting, as he is accountable for the same. As for the repairs, if neglected or improperly done, the records will show and the responsibility can be attached to the proper parties.

Question 3. I believe it best and most satisfactory for the joint man to be a stranger, although if otherwise he will readily see his only course is to do what is right and impartial, so that he need not fear an investigation at any time.

Question 4. He should be governed by the M. C. B. rules, taking them as a standard; at the same time he will have to make hundreds of decisions that the rules do not cover. He will have to rely on instructions from his superior officers of the different roads for which he works—they knowing what they have to contend with—and his own judgment.

Question 5. The M. C. B. rules do not cover all the questions involved in the interchange of cars, nor ever will, until there is a standard built by all companies, which is not visible at present.

Question 6. If each joint inspector was allowed to use his own judgment, and it being final, would create such a diversity of ideas and modes of inspection that a car going from New York to San Francisco would probably have to be rebuilt several times before reaching its destination. Therefore the M. C. B. rules should be a guide, even though they may not be all that is required, but should be used as a basis for all additions and interpretations, so as to have the inspection conform as nearly as possible at all interchange points.

Question 7. It would certainly be very uncomfortable for any joint inspector if his superior officers did not have confidence in his ability and integrity. I do not know as it would operate any worse for him than any other railway official in the same position.

Question 8. It should be in all ordinary cases, where a car or cars have been in an accident involving old and defective cars there should be no objection to the parties interested to come to a settlement.

Question 9. It has been done successfully. J. C.

Editor National Car and Locomotive Builder :

By directions of Jas. Meehan, Superintendent of Motive Power of the Cincinnati, New Orleans & Texas Pacific Railroad, tests were made with engine No. 30 of this road in order to determine why she was not showing the same economic results as others, it being the custom on this road to test all engines at intervals with a view of keeping them at a higher state of economy than is possible from engineers' reports and examinations of performance sheet. Cards 1, 3 and 5 were taken before any change was made, as was the test of consumption of coal and water. Cards 2, 4 and 6 were taken afterward. Cards 1, 3 and 5 show at a glance the great difference between the initial cylinder pressure and boiler pressure. An examination of the steam ports was made, although this was not deemed necessary, as it would have been next to impossible that both steam ports be so equally blocked by defective casting of cylinder as to show such evenness in the loss of pressure in both ends of cylinder. The same reasoning would show the branch or steam pipes were not clogged. It was found the lift, or throttle pipe, had had a square brace, 1⅛ inches square, cast across it to strengthen it. This was cut out, eccentrics advanced, and cards 2, 4 and 6 taken with accompanying test of coal and water.

Coal used on this road is of such poor quality that, as an engineer aptly expressed his idea, "it would not burn in Hades with the blower on." Consequently the evaporation was low per pound of coal, running from 5 to 5½ pounds of water per pound of coal. The water consumption was remarkable, running from 21 pounds to 23 pounds per horse power per hour, while the improvement in the nearer approach of initial cylinder pressure to boiler pressure is apparent. Cards as nearly similar in speed, etc., have been selected, taken before and after, as 1 and 2, 3 and 4, 5 and 6. Cards 6 at less revolutions, in same notch, show greater horse power, and with less coal and water, cards 4, in second notch, show a development of power close to cards 3, in third notch. Cards 2 show similar improvement over cards 1.

If an argument were wanted to urge the more extended and frequent use of the indicator, it is found in these cards, and it is the writer's belief that all superintendents of motive power would do well to follow Mr. Meehan's practice, in the almost daily use of this most invaluable instrument.

FRANK C. SMITH.

CINCINNATI, NEW ORLEANS & TEXAS PACIFIC RAILWAY.

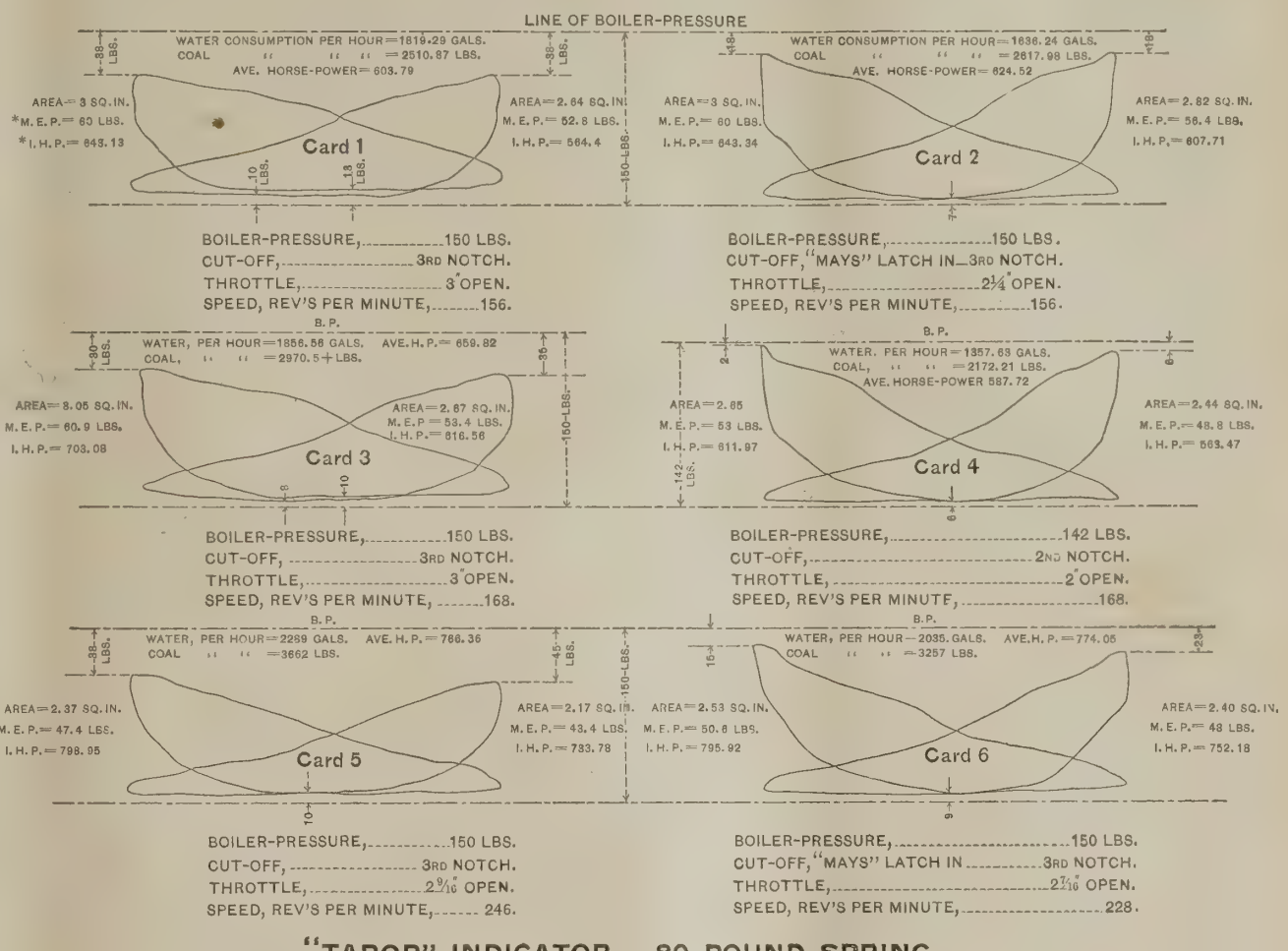
INDICATOR DIAGRAMS—ENG. 30—LEFT SIDE "CYLINDER."

NUMBERS 1, 3 & 5 WERE TAKEN AUG. 18, '89, FROM LUDLOW, KY., TO HIGH-BRIDGE, KY., TRAIN 14 CARS.
2, 4 " 6 " " " " 23, " " SOMERSET, KY., TO OAKDALE, TENN., " 5 "

CARDS 1, 3 & 5 WERE TAKEN AFTER REMOVING 1-32" A SIDE, INSIDE LAP, INCREASING NOZZLE TO 5" DIAMETER AND ADVANCING FORWARD MOTION ECCENTRICS 3-32".—CARDS 2, 4 & 6 TAKEN AFTER REMOVING 1 5-8" SQUARE STIFFENING-RIB IN ELBOW OF THROTTLE-PIPE, IN CONNECTION WITH AFORESAID ALTERATIONS.

JAMES MEEHAN, — SUPT. M. P. AND M. — — LUDLOW, KY. — — AUG. 29, '89. —

FRONT END. BACK END. FRONT END. BACK END.



"TABOR" INDICATOR. 80 POUND SPRING.

Scale, One-Half.

*M. E. P, MEAN EFFECTIVE PRESSURE.
*AVE. H. P., AVERAGE HORSE-POWER.
*I. H. P., INDICATED HORSE POWER.

Economy of Oil Versus Economy of Coal.

Editor National Car and Locomotive Builder:

As the cost of supplies for engines forms such a large proportion of the operating expenses of the locomotive department of railroads, it is of course very important that careful economy should be exercised in the use of all engine supplies; and such economy is best effected by impressing the enginemen who use the supplies with the necessity of a careful and judicious use of same.

When this is properly done good general results are sure to follow, and materially decrease operating expenses. But lines of economy are sometimes pushed in the wrong direction, and result in serious ultimate loss. Such is the case when a too rigid economy in the use of lubricating oil is practiced. Coal, not oil, is the expensive supply for locomotives, and to its most economical use railroad officers who are earnest in their efforts to reduce operating expenses may most profitably devote their attention.

A close relation exists between the judicious use of lubricating oil on the rubbing surface of locomotives, and their consumption of coal. The objects of lubrication are not only to prevent wear and injury to the surfaces in contact, but also to reduce the retarding action of friction to the lowest possible degree, and thus make easier the necessary effort to drive the machine, or run the machine and *economize in the use of power.* As the power of locomotives is derived from the heat generated by the combustion of coal, it is plain that if, from imperfect lubrication, more power is used to overcome friction and run the engine, the consumption of more coal to furnish that power is unavoidable.

This fact, though plain, is not always recognized and properly appreciated, and on some railroads greater efforts are made to save in the price and stint in the use of lubricating oil than to economize in the use of coal. The practice is false economy and leads to a consumption of coal, the value of which far exceeds the value of the amount of oil saved. A veritable "saving at the spigot and wasting at the bung."

Recently, upon a prominent railroad, special effort was made to economize in the use of lubricating oil for locomotives; and, to stimulate the zeal of the engineers to effect the desired economy, the engines were ranked, in the monthly exhibit of their performance, according to the number of miles run per pint of lubricating oil, regardless of their consumption of coal. Four engines were engaged in local freight service on a division, and the following is a copy of the exhibit alluded to for two months :

AUGUST.

Engine.	Rank.	Miles run during month.	Miles run to one.			
			Pint of valve oil.	Pint of engine oil.	Total pints of lub. oil.	Ton of coal.
A.....	1	1,819	47.9	40.0	21.7	21.7
B.....	2	2,067	28.7	23.5	12.9	19.9
C.....	3	2,867	27.6	20.2	11.6	21.9
E.....	4	2,338	28.5	15.0	9.8	27.5

SEPTEMBER.

Engine.	Rank.	Miles run during month.	Miles run to one.			
			Pint of valve oil.	Pint of engine oil.	Total pints of lub. oil.	Ton of coal.
A.....	1	1,779	40.4	24.7	15.5	17.8
B.....	2	1,883	24.8	23.5	12.1	17.4
C.....	3	2,344	23.9	19.5	8.6	15.4
E.....	4	2,139	21.4	12.7	8.0	20 2

It is interesting to note that Engine E, ranking poorest in this exhibit because it used more oil that the others, effected a considerable economy in the consumption of coal, as compared with the other engines. In August engines A, B and C averaged 21.1 miles per ton of coal, while engine E run 27.5 miles per ton, effecting a saving of 22.1 pounds of coal per mile, or (22.1 × 2,338 miles run in month =) 28.5 tons, or (at $1.50 per ton) $38.70 in the month.

In September engines A, B and C averaged 16.8 miles per ton of coal, while engine E run 20.2 miles per ton, effecting a saving of 14 pounds of coal per mile, or 15 tons, or $22.50 in the month. The value of the amount of coal saved in the two months was $61.20.

All four engines used in August 91 gallons, and in September 94 gallons of lubricating oil. Total, 186 gallons, which, at an average of 12 cents a gallon, cost $22.32. So engine E, although ranking poorest in economy of oil, saved, in the two months, an amount of coal the value of which exceeded the cost of all the lubricating oil all four engines used in that time, with the handsome balance of $38.88 over and above.

The economy of engine E was effected by the engineer's careful management, and a judicious and probably liberal use of lubricating oil.

Generally speaking, engineers are drilled too much on the importance of economizing in oil, and too little on the far greater importance of economizing in coal, and, naturally falling in with the views of their officers, too many regard lubrication as having but one object, and that is to "keep her from running hot," and that the least possible amount of oil used to avoid that result, the better. To prevent the development of heat is but one of the several objects of lubrication, and though important, it should not be considered the chief; but oiling should rather be done with a view to cause rubbing surfaces to glide easily with the least possible expenditure of power. And if, while appreciating the importance of avoiding waste in the use of any supply, we are yet to err in the use of lubricating oil, we err on the side of safety and economy when we are liberal in its use.

GEO. H. BAKER.

Before the days of the telegraph it was not as simple a thing to run a train as it is now. Accidents of a very peculiar nature were of frequent occurrence. While chatting with a Harlem conductor the other day, he told the following story: "A south-bound freight train on the Harlem road left Dover Plains at the usual time; the train was quite long, and in the middle of it was a new box-car, loaded with flour. Brandt, now dispatcher at Dover Plains, was the conductor; I don't remember now who the engineer was. They ran all right until they came to the bank just below Croton Falls, when the train broke in two. The front part of the train ran on down the hill till Purdy's was reached, when the other half overtook it, and was coupled on again, and the train proceeded to Bedford, when, upon looking over the train, Brandt found that the new car loaded with flour was missing. No one could imagine how it had disappeared, and there was nothing to do but to finish up the trip which they did. When they went back next day they found the car lying at the foot of the bank at Croton Falls. It had jumped the track when the train broke in two."—*Railroad Men's Monthly.*

NATIONAL CAR AND LOCOMOTIVE BUILDER

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ANGUS SINCLAIR, Editor.

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EDITORIAL ANNOUNCEMENTS.

Advertisements.—*Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING COLUMNS. *The editorial department will contain our own views and opinions; and the rest of the reading matter, aside from advertisements, will be such as we consider of interest to our readers.*

Contributions.—*Articles relating to railway rolling stock construction and management, and kindred topics, by those who are practically acquainted with these subjects, are especially desired. Also early notices of changes in railroad officers, organizations and names of companies.*

Special Notice.—*As the* CAR AND LOCOMOTIVE BUILDER *is printed and ready for mailing on the last day of the month, advertisements, correspondence, etc., intended for insertion, must be received not later than the 25th day of each month.*

To Subscribers.—*We occasionally receive complaints from subscribers that their paper is not received regularly. When cause for such a complaint exists, the blame lies with the mails or with the method of delivery, for the paper is mailed regularly to every subscriber each month without mistake. Any subscriber who fails to receive his paper ought at once to notify the postmaster at the office of delivery. When a subscriber changes his address he ought to notify this office at once, so that the paper may be sent to the proper destination.*

Smoke Stacks are Too Large.

There are many parts of railroad rolling stock where proportions have been established and maintained by thumb rules that have no sensible relation to the dimen sions which they regulate. The smoke stack of a locomotive performs very important functions in the operations affecting the combustion of coal, yet the majority of smoke stacks are designed without any rational relation to the other mechanical elements that control the combustion of fuel. Many years ago, before coal became the common fuel for locomotives, investigators found out, by experi ment, what size of smoke stack in relation to the grate area, flue section, etc., gave best results; but it is doubtful if the rules then formulated apply properly to modern conditions, yet it would be sensible and logical to use them instead of the rules commonly followed. To make a smoke stack one or two inches less than the diameter of the cylinders of the engine is an exceedingly simple rule, but it would be quite as philosophical to regulate the diameter of the driving wheels by the stroke of the engine, or the spread of the truck wheels by the speed to be run. Since the open stack became common, some of our most intelligent master mechanics have *experimented* to find out what diameter of stack gave the best results, and the testimony of every one who has made exhaustive tests goes to prove that the thumb rule of proportioning the stack to the cylinder is wrong. The great weight of evidence indicates that the diameter of nearly all stacks in use is too great for economical service. The most careful experimenters have found that by reducing the diameter of the stack they could increase the diameter of the nozzles, which means that, with a properly proportioned stack, the vacuum in the smoke-box necessary to maintain proper draught of air through the fire could be obtained with a less velocity of exhaust steam than where a larger smoke stack was employed. The draught obtained is also more uniform. When a large stack is employed an engine may steam well when pulling hard but indifferently when working light, or *vice versa*. There is greater difficulty in regulating the action of the exhaust steam so that the pull on the fire will just be sufficient to meet the requirements of steam-making.

At the Master Mechanics' conventions, and at club meetings of railroad men, those who have experimented with smoke stacks have repeatedly given particulars of their experience and of the coal saving effected by improving the form of stack; but this kind of teaching appears to exert very little influence on others. The rank and file of master mechanics pay no attention to the matter. Some of them try in a perfunctory manner a smaller stack, and do nothing to make the other draught appliances harmonize with it. When the man running the engine fails to see that a great improvement has been effected, they conclude that the old size and form of stack is good enough for them. Locomotive engineers are a highly respectable class of men, but progressiveness is not one of their peculiarities. They will nearly always cling to forms and practices that are old, and new ones are regarded with suspicion. The master mechanics, then, who depend on the commendations of the engineers as authority for the success of any new improvement are likely to continue in the beaten track. It is their duty to find out forthemselves the value of any improvement, and this can only be accomplished by the making of tests.

When the subject of the relative proportions of cylinders and stack diameters was under discussion at the last Master Mechanics' convention, sufficient testimony was given in favor of reduced diameter of stacks, to convince unprejudiced persons seeking for truth, that the old diameters are wrong, but it appears to be doing little good. Mr. L. C. Noble, of the Houston & Texas Central, testified that for two years he had been making evaporative tests to find out what forms of stack and nozzle gave the best results. He started by reducing the diameter of stack and increasing the diameter of the nozzles, and the evaporation of water per pound of coal was materially increased. Mr. T. W. Gentry, of the Richmond & Danville, Mr. Montgomery, of the Central of New Jersey, Mr. O. Stewart, of the Fitchburg, and others gave evidence to the same effect, and there was nothing said by others to indicate that there was any merit in the common big stack practice. With all this and much more testimony in favor of reducing the prevailing diameter of stack, it seems as though those who keep putting on those of the old wasteful sizes are not working for the best interests of the companies employing them.

Since the testimony in favor of smaller stacks above referred to was given Mr. John Mackenzie, of the New York, Chicago & St. Louis, had an experience which is well worth relating. Mr. Mackenzie had no faith in the claims made for the reduced size of smoke stack; but he had an engine which was not working satisfactorily. The engine had been newly turned out of the shop, fitted up with all improvements calculated to make a locomotive produce a good record, and she was placed on the principal passenger train. She did fairly well in every respect except that she was not light on fuel. As an experiment Mr. Mackenzie had a smoke stack of reduced diameter put on, and this change at once reduced the consumption of fuel, and the engine is now regularly making the round trip with one ton less coal than was used before to do the same work. The case is by no means a novel one either. Any doubting Thomas may receive all particulars of this by dropping a line to Mr. Mackenzie.

Defects of Brakes.

Public tests of good brakes of maximum power, properly applied, have made the public familiar with the promptness with which trains running at high velocity can be stopped; yet those who travel much on express trains are often amazed to find the long distance that is required to bring the train to a state of rest when a demand for sudden stopping arises unexpectedly. This means that with the brakes applied as it is possible to arrange them, a stop can be made so quickly that there is little danger of accidents happening; but that owing to the prevailing method of arranging the power of brakes, they seldom stop a train in less than twice or three times the distance that ought to be required. This dangerous condition of affairs has actually aroused criticism and public protest. In press discussions on the subject, a case has been expatiated on where a vestibuled express train, which got an unexpected signal to stop while running on a level track, ran 2,000 feet before being stopped. This has been regarded as an exceptional case, but we have the best of reasons for knowing that it would be found to be the rule, rather than the exception, on many roads, if investigations were made. There are very few trains of Pullman cars with six-wheel trucks that can be stopped in less distance than 2,000 feet, from a speed of 60 miles an hour, when suddenly signaled. Accidents have repeatedly happened that would have been avoided had the trains been properly equipped with brake power, but none of them have yet been of a character sufficiently serious to direct public notice decidedly to this source of danger. Unless, however, those who are responsible for permitting trains to run with inefficient braking capacity bestir themselves to have the danger remedied, there will be cause for reckoning some day, for the effect in the form of a sanguinary accident is certain to follow the cause when sufficient time is given.

Under the existing state of affairs a train is speeding along at about a mile a minute, when the engineer gets a sudden signal to stop. He applies his brakes, and the train hardly feels them for the first three or four hundred feet, then they begin to reduce speed, and within the next 1,000 feet are steadily reducing the velocity; but another train happens to be on the track at the end of that distance and a smash occurs, that destroys a good deal of property, and perhaps blots out a life or two. Reports are immediately published, which say that from some cause the brakes did not hold. If there was a proper system of investigating railroad accidents and of reporting on the same, the additional information would be forthcoming that the brakes failed to stop the train in time, because there was not a proper amount of braking power provided. What is badly wanted as a means toward a remedy is more light on the cause of accidents.

Various causes contribute to limiting the braking power on trains. The most conspicuous cause of deficiency is the practice of running six-wheel trucks with brakes applied to only two pairs of the wheels. This practice is without excuse, and is an outrage on the traveling public When no means had been devised for applying brake-shoes to the middle wheels of a six-wheel truck, the man responsible could not be blamed for failing to apply the proper braking power to cars using trucks of that character; but there are now several well-known gears in use that provide good means of applying brake shoes to all the wheels of six-wheel trucks, and it is only apathy, carelessness and mistaken sentiment of economy that stand in the way of their general adoption. It is bad enough to have a large proportion of the car wheels in a train without brakes, but that does not by any means cover the deficiencies of brake power. There is so much tenderness displayed on some roads towards the wear of wheels, that the braking power applied is systematically kept way below the safe maximum, to make sure that sliding of wheels will not take place. It is all very well to save wheels, but it ought not to be done at the expense of safety. Sliding of wheels is not, however, generally due to excess of braking power on a car, but to carelessness and ignorance in the adjustment of levers and brake shoes. If there was proper attention bestowed upon making every wheel under a car take an equal share of the brake-shoe pressure, there would be very little complaint about wheel sliding, and there would be no inducement to reduce leverages. But the most amazing carelessness prevails about the keeping up of brakes, and hundreds of wheels are monthly slid flat through the neglect or stupidity of the inspectors.

A suggestion has been made and freely discussed to apply brake shoes to the engine trucks of locomotives as a means of increasing the available braking power. This may some day become necessary, but at present it is more important that efforts should be made to apply the maximum safe braking power to the other wheels in the train. Every month there are hundreds of cars arriving at terminal stations with the piston in the brake cylinder at the end of its travel. The whole of the brake on every car in this condition is useless. Simple means might be devised to compensate for the wear without permitting the brake to become inoperative, or the gauge that shows the travel of the piston might be brought into more general use. Brake shoes ought to be applied to every wheel behind the engine truck, the leverage ought to insure the application of power only short of sliding the wheels, and the brake gear should be maintained properly. If these reforms were effected there would be no complaint of express trains being unmanageable, there would be no complaints about brakes failing to act, the traveling public would be carried with moderate safety, and there would be no necessity for applying brakes to engine trucks.

Uniformity in Car Construction.

Ever since the M. C. B. Association was organized it has been constantly laboring to introduce standard dimensions and forms for the different parts constituting a car, and has succeeded in establishing quite a number of them. Of these, however, a few only have been generally adopted, but fortunately those of the greatest importance; they are screw threads for bolts and nuts, axles, journals and journal bearings for cars of 40,000 pounds capacity. The journal-box itself cannot be considered a success, as it is incomplete without a lid, consequently not interchangeable, and is of value only in that it makes a standard journal-bearing and key possible.

The standard height for draw bars is the next best enforced recommendation, all others receiving but an indifferent support.

The indications are that the M. C. B. standards will be more universally adopted in the future. The very gratifying results of the letter-ballot on those submitted by this year's convention would at least lead one to believe so. The most important of these is the axle for cars of 60,000 pounds capacity, designs for which were repeatedly submitted, but never succeeded to obtain the necessary number of votes. Those laboring for the adoption of *some* axle had almost given up hopes of reconciling the different opinions, and, as a last resort, proposed to compromise by offering *two* standards; but, fortunately, this was not done. It will be some time before the beneficial results of this measure will be felt, but eventually the new axle is certain to predominate to the same extent as that now used for the lighter cars has.

The association should take advantage of this evident inclination to agree and present more new matter, as well as re-submit that which has been defeated. Prominent among the subjects for next year's subjects is the journal box to go with the new axle, which, since the dimensions of the journal have been settled, should not prove a difficult problem.

The Fletcher lid has been adopted, but the necessary dimensions to make this of practical value were rejected; however, should the committee having charge of this matter present a design and *all* the dimensions of this lid—one that will answer for both boxes—it will probably receive the requisite number of votes at the next ballot. There is no reason why those agreeing on the form of the lid should oppose the dimensions when properly presented.

A defeated design should not always be abandoned, and the labor expended upon it is not altogether wasted. The

truck proposed some years ago, and which was rejected, might possibly be adopted, now that it is better known, and especially if those portions relating to rigid bolsters were modified. A large number of these trucks have been built since the design was first published, and some roads use it, or something very much like it, exclusively for new equipment.

An effort should again be made to establish standard dimensions for freight cars, and standard sizes for the timbers used in their construction. The beneficial results such an act would produce are too apparent to require a special enumeration, and we are confident that something can be accomplished if this matter is persisted in. The last time this question came up it was proposed to use the same sizes for both 40,000 and 60,000-pound cars. This was evidently a mistake, as those suitable for one must necessarily be out of all proportion for the other. The lengths of the different sizes were also omitted, and without this the other dimensions would be of little value. If this subject is again presented, the general dimensions of the car should be first settled and then the different members be separately voted on, so that the rejection of one would not affect the others.

Uniformity is also desirable in the manner of framing, especially of those parts that are most liable to fail, such as draught timbers, end sills and end frames, but it is most important in those portions now generally made of cast iron. Those familiar with the repairs of *foreign* cars best understand the annoyance caused by the variety of forms met with. If a car is at all injured, some of the cast-iron work is almost invariably fractured, and to replace it requires either the making of new patterns or sending for the parts to the owners of the car; both proceedings are expensive and often delay a car for weeks after all other repairs have been made. The introduction of steel plates and malleable iron as a substitute for cast iron, the merit of which is now being investigated by a committee of the association, promises to afford some relief in this direction, as the articles made from these materials will be more durable, but on the other hand, cannot be produced at the local shops but must be purchased from parties making their manufacture a speciality.

The Cause of Fires.

The various railroad clubs throughout the country have discussed so many of the subjects that are of conspicuous interest to railroad men that they are finding it necessary to work over old ground. For those interested we would suggest that they might with advantage discuss the cause of fires in shops and buildings. Every railroad man is interested in this subject. Many of the members of our clubs have had personal experiences with fires that would enable them to give interesting and valuable information to those whose turn has not yet come. Those who have not had the whole or part of their buildings burned down might, on the other hand, give valuable hints about how they have succeeded in preventing fires. The methods of preventing fires and how to handle them, if they do happen, would cover the whole subject.

Practical men are too often disposed to despise and reject theories based on the laws of chemistry respecting the origin of fires ; but there is no doubt that many destructive fires are due to spontaneous combustion, and all concerned ought to devote careful attention to what experts in chemical investigations have to say on the subject. Prof. W. P. Tonry, who has made the origin of fires a special study, says of spontaneous combustion: The flame in such cases invariably arises from a combination of oxygen with some material favorable to producing heat. Wherever there is turpentine there is always danger of spontaneous combustion. If the substance be poured on rags, especially when they are soaked with grease, fire is likely to result. Furniture establishments and all places where oils and turpentine are kept are especially liable to visitation from fires of inexplicable origin. Hay, when moist and packed tightly, ferments by a natural process and absorbs oxygen so freely as to produce flame in many instances. Sulphuric acid, if allowed to come in contact with bagging at fertilizing factories, is also a source of great danger. The same acid, if mixed with water, produces intense heat. A common source of unexpected combustion is the gas which escapes from a jet which has been carelessly left open. Gas and common air produce an explosive compound which can be touched off like gunpowder by a tiny flame.

Professor Tonry says it is difficult to prevent combustion which arises from natural combinations, although thorough ventilation and cleanliness in private houses and business establishments will go a long way toward reducing the danger. The phenomenon is common to all seasons, although a temperature of 70 to 80 degrees, which is high enough for fermentation, is most favorable to it.

An accumulation of inflammable materials is always to be avoided. It was once believed that human bodies, especially those of inebriates, were liable to take fire and be consumed spontaneously, but the theory finds but little acceptance in these days.

Dead Weight of Freight Cars.

The light weight of a car is very improperly termed dead weight, because no direct charge for hauling it can be made. The weight of the materials used in the construction of a locomotive is generally not so considered, for without it neither dead nor paying load can be moved. But if this is true in the case of the locomotive it must be equally so in the case of the car, as without cars or some other means for containing the articles to be transported, these would remain stationary.

Dead weight does, however, exist in both instances when the construction is faulty, and the different parts making up the whole are heavier than the service they are required to perform calls for, or when weak and heavy material is used where equally strong and much lighter substances are available, always keeping in sight, however, the comparative first cost and maintenance.

The American freight cars compare favorably in this respect with those of other countries, even with those of Europe, where the roadbeds and tracks are much more perfect than they are with us. The average weight of our modern freight cars is perhaps not far from 33,000, 30,000 and 24,000 pounds for those of 60,000, 50,000 and 40,000 pounds capacity respectively, which is equal to 58 per cent. of the paying load, while the average weight of a number of European cars that we have data on is 69.34 per cent. Comparing it with the cars of India, where the conditions are more like our own, and where the American system of long cars mounted on trucks has been more extensively adopted than anywhere else, the figures are equally as favorable, the average light weight being about 65 per cent. The comparisons are of course made with wooden and *covered* cars. Nearly all the modern cars in the countries mentioned are constructed with iron or steel floor or underframes, and in many instances almost entirely of iron or steel, and consequently are much lighter.

It would be equally unfair to compare our box cars with the open cars so much in vogue there, and which weigh but 60.62 per cent. of the registered capacity. Our gondola cars resemble these more closely, and as far as weight is concerned, may be fairly used for our purpose; their weight is about 50 per cent.

The above figures indicate that either our method of construction is superior, or that the strength of the material is more taxed, and the cars more liable to break. However this may be, the dimensions of the timbers and wrought-iron parts in our cars are undoubtedly none too ample, and to cut them down enough to make any appreciable impression on the weight would leave the cars too weak for the severe service demanded of them. There are, however, some parts that can be reduced in weight with profit and safety; they are those now made of cast-iron, of which heavy and comparatively weak material there is too much about a car; in fact, it is used for all articles that cannot be economically forged by hand from wrought iron.

It would be proper to continue its use if something better were not available. Malleable castings can safely be used for all those parts that are not subjected to excessive tensile stress and torsion, nor to much wear, but are most suitable for the smaller articles. Other parts, as center-plates, stake-pockets, etc., may be pressed or stamped from sheet or plate steel and iron, while drop forgings can serve in still other instances. The cost will in no case be increased by making this change, but will in many instances be slightly reduced, the loss from breakages be decreased, and the weight—the subject under consideration—be reduced one-half. But, do all we can in this direction, the total reduction in the weight of the car will not exceed three or four per cent., and all speculation as to radical changes in this respect will prove futile as long as cars continue to be constructed of wood.

Interchange of Cars.

A contributor in our last issue propounded a number of questions relating to joint car inspection, by which means it is proposed to somewhat allay the annoyances and delays resulting from the present system.

The subject is an interesting one, and, considering the enormous proportions the interchange of cars has attained at the present time, one of great importance. It should be thoroughly discussed at the club meetings of the coming season.

Joint inspection is desirable both for reasons of economy and to reduce the delay of cars at junctions to a minimum. To illustrate the first, at a transfer station where the interchange is but light, but occurs at all hours, each of the two or more companies interested is compelled, under the present system, to maintain two inspectors, one for day and the other for night work, although there may not be work enough for one. It may be argued that a good man can find enough to do about the cars of his own company to keep himself employed; but in fact very little of this work is done, possibly because these men, being not under direct surveillance, naturally take advantage of this. By establishing a joint inspection at such a place one-half of these men can be dispensed with.

At points of more importance, where a considerable number of men, under the immediate supervision of a foreman, are employed, a reduction is not possible; but the second reason why joint inspection would be desirable, that of facilitating the movement of cars, holds good in both cases. It is a well-known fact that the inspectors of the different companies are seldom on good terms, and for this reason frequently make the business in hand a personal matter. Aside from this, the different constructions put upon the Association rules—and often because of this inclination to obstruct—cause serious delay. The rules are perhaps as perfect as they can be made—at least no pains have been spared to make them so—but cases will come up that puzzle cooler and more competent heads than can be retained at from forty to sixty dollars per month.

Joint inspection is, of course, not a radical cure for all the evils, but it will make them less annoying. A man is not very apt to quarrel with himself, nor will he place different constructions upon the same rule, and it may therefore be fairly assumed that all *avoidable* delay to cars in transit will be done away with.

The above are some of the advantages of joint inspection, but as nothing human is perfect it is but natural to find objections, and it is a question with many whether the good or bad features predominate most. The principal object of all inspection being the detection of breaks or other defects liable to endanger the safety of the train, this is the first point to be considered. Under the present system of separate inspection these defects may be overlooked, but owing to the desire to make work for the opposing inspector are more apt to be discovered than when there is no such incitement.

Another difficulty presents itself in the selection of the proper person for the position; if the party selected has previously been employed by either of the companies interested he may be partial in his decisions, but all these objections are of but little moment when honest men are employed, and men, as a rule, are honest, if not always competent, and incompetent persons can do as much harm under one system as another.

Joint inspection is, in our opinion, practicable. At the points where it has been established, as in Kansas City and St. Louis, not to mention numerous places of less importance, it must have proved satisfactory, as it is continued in operation.

Stimulating the Adoption of Safety Appliances.

The petition sent by certain brakemen and other railroad employés to the Inter-state Commerce Commissioners, asking that means be taken to bring about the adoption of automatic brakes and couplers on the freight cars in the United States, has been the subject of considerable adverse comment. We fail to see that there was anything wrong or out of place in the petition. Several months ago the Inter-state Commissioners sent out circulars to all classes of persons interested in railroad operating, asking for suggestions, and the petition referred to was one of many answers returned. For years it has been the custom of parties opposed to the introduction of automatic couplers and other safety devices to interview brakemen and switchmen with the view of receiving disparaging reports about the utility and safety of devices designed to prevent accidents. They seldom failed to obtain the expressions of opinion desired, and these were sent out wherever the telegraph and the mail extended, as the views of the men most interested. It is only right and proper that the same class of men holding different views should now take the opportunity of putting themselves on record. We can conceive of no more legitimate purpose of employés' unions than that of making public the dangers connected with their occupation that may be removed by the introduction of good mechanical appliances.

The introduction of automatic brakes and of automatic couplers to freight cars is proceeding very satisfactorily, and many railroad companies are making the improvement as fast as they are able to do so. But some roads are doing nothing. Some are waiting to obtain the benefit of the experience gained by others, with the intention of using that to their own advantage when they get ready to apply conplers or brakes, or perhaps both. Other companies again are doing nothing, and have no intention of ever applying brakes or any form of improved coupler to their freight cars. The latter kind of company not only displays callousness toward the human beings that must constantly be killed or maimed by the use of inferior and defective appliances, but they inflict injury on all connecting lines by reducing the efficiency of their perfected car attachments. It is easy to anticipate a time when not only trainmen and those interested in the preventing of human suffering, but when the leading railroad companies, may be interested in urging legislation respecting the adoption of safety appliances. We believe that legislation on this matter has in the past done more harm than good, and that it would be for the benefit of all concerned to maintain a watchful truce for some time to come. But it will exert a very healthful effect on many railroad presidents to know that powers greater than they are ready to enforce progress if it is not entered upon voluntarily.

Some interests in this country appear to be laboring very industriously to boom the metal aluminium. According to the statements spread broadcast over the country, this metal is stronger than steel, nearly as light as cork, and as free from corrosion as gold. There is no doubt but the metal has peculiarities which would make it highly valuable in the arts if it could only be produced cheaply, but attempts to prove too much for it are likely to bring a good thing into disrepute.

Personal.

Mr. E. E. Jenks, master mechanic of the Ohio River road, has resigned.

Capt. Geo. Skinner, superintendent of the Chattanooga, Rome & Columbus R. R., died at Rome, Ga., on Oct. 1.

John Creerar, senior member of the great railroad-supply firm of Creerar, Adams & Co., died in Chicago on the 19th inst.

Mr. F. Yonng, master mechanic of the Terre Haute & Peoria, has resigned, and has been succeeded by W. G. Van Buskirk.

J. A. Barnard, formerly purchasing agent of the Ohio & Mississippi, is the new general manager of the Ohio, Indiana & Western, now consolidated with the Big Four.

Mr. Daniel Robinson, of Troy, N. Y., died on Sept. 24. He was president of the Troy & Boston Railroad for many years, and was the principal projector of the Hoosac tunnel enterprise.

Mr. Fred C. Hills has been appointed general superintendent and James Maboney general traffic manager of the Souix City & Northern Railroad, the appointments to go into effect November 1.

Mr. George W. Stevens, who recently resigned as purchasing agent of the Ohio & Mississippi to enter the employ of Fairbanks, Morse & Co., has again returned to the Ohio & Mississippi as purchasing agent.

Master Mechanic Twombly, of the Rock Island Railroad, sent in his resignation, pending the investigation of the suburban railroad wreck at Chicago. G. F. Wilson has been appointed acting master mechanic of the road.

Mr. James Montgomery, superintendent of the Ohio Valley Railway, has resigned, and Mr. W. Hegeman, who has been connected for many years with the Baldwin Locomotive works, has accepted the offer to fill the vacancy.

Mr. Robert Law, superintendent of the Montana Union, having resigned, William H. Baldwin, recently general manager of the Leavenworth Division of the Union Pacific, has been appointed to supersede him, with the title of general manager.

Superintendent Porter, of the Census Bureau, has appointed Charles H. Cooley, of Michigan, special agent of the bureau for the collection of railway statistics. Mr. Cooley is the son of Judge Cooley, of the Interstate Commerce Commission.

Mr. Albert B. Ropes, engineer of tests of the Southern Pacific Railroad Company, died at Sacramento, Cal., Oct. 8. Mr. Ropes was a graduate of Stevens Institute, class '82, 27 years of age, and was a very promising young man. His remains were sent to Orange, N. J., the home of his mother, for interment.

Mr. Robert C. Ford, recently appointed general manager of the Colorado Coal and Iron Company, died at Pueblo. Col., last week. Mr. Ford was formerly superintendent of the Clearfield & Jefferson and Bell's Gap road in Pennsylvania, which position he resigned to go to the Colorado Coal and Iron Company.

Mr. J. F. White has been appointed master mechanic of the Fort Worth & Denver City road, succeeding Mr. E. P. Henderson, who has been appointed to the position of master mechanic of the Denver, Texas & Fort Worth, a place made vacant by the recent retirement of Mr. Frank W. Morse to enter the service of the Wabash.

Sir Daniel Gooch, the English engineer, died Oct. 15, He was born in 1815, and learned his profession under Robert Stephenson. For many years he was chief locomotive engineer of the Great Western Railway and Chairman of the board of directors. He was one of the original shareholders in the steamship "Great Eastern."

Mr. O. A. Rogers has been appointed general superintendent of the McKeesport & Belle Vernon Railroad, now in operation from Monongahela City, Pa., to McKeesport, 17 miles, to succeed Mr. James Ritchie. Mr. Rogers has been in the service of the Pittsburgh & Lake Erie since 1886, and was with the New York & New England prior to that time.

Mr. Cecil Gabbett has been appointed general manager of the Central Railroad and Banking Company of Georgia, to succeed Mr. M. S. Belknap. Mr. Gabbett is a civil engineer of 20 years' experience, and has been connected with Southern railways most of the time since 1870. Since 1886 he has been general manager of the Western Railway of Alabama, the Atlanta & West Point, and the Cincinnati, Selma & Mobile.

Mr. K. H. Wade, who was general superintendent of the Wabash under the receivership, and who resigned at the time of the consolidation with the Wabash Western, has been appointed general manager of the California lines of the Atchison, Tepeka & Santa Fe. He succeeds Mr. Daniel McCool, who was appointed general manager of the California Southern and California Central last February. Mr. McCool was formerly general manager of the St. Joseph & Grand Island.

Mr. D. J. Chase, general superintendent of the Chicago, Santa Fe & California since June, 1887, has resigned and has been succeeded by Mr. C. O. Wheeler, at present division superintendent of the Wisconsin Central. Mr. Chase has been successively division superintendent, superintendent of transportation and general superintendent of the Atchison, Topeka & Santa Fe previous to his appointment as general superintendent of the Chicago, Santa Fe & California.

The control of the Ohio, Indiana & Western having passed into the hands of the Cleveland, Cincinnati, Chicago & St. Louis road, Charles E. Henderson has resigned his position of general manager, and has been succeeded by J. A. Barnard, who is at present purchasing agent of the Ohio & Mississippi. Mr. Henderson continues as general manager of the Ohio Southern. He was appointed general manager of the Indiana, Bloomington & Western in October, 1881, and in July, 1886, he became receiver. On its reorganization as the Ohio, Indiana & Western he was again appointed general manager.

Mr. F. B. Phillips, President of the Fitchburg, has resigned on account of ill-health. He has been President of the Fitchburg since Nov. 4, 1883, and has been in railroad service half a century, his first position being on the Boston & Worcester as freight receiver. He was promoted till he became Superintendent, and has since been Superintendent of the Cleveland & Toledo, President of the Michigan Southern & Northern Indiana, President of the Lake Shore & Michigan Southern, President of the Phillips & Colby Construction Co. (builders of the Wisconsin Central), Receiver of the Grayville & Mattoon, President of the Eastern and also of the Toledo, Cincinnati & St. Louis, and then President of the Fitchburg.

Mr. M. J. C. Wrenne, superintendent of the Nashville, Chattanooga & St. Louis for the last eight years, has been appointed general superintendent. Mr. Wrenne has been with this road since 1862, having entered the employ of the Nashville & Chattanooga at that time as a clerk in the transportation department. He was trainmaster over 15 years. Several other important changes and promotions have been made on the road. Mr. Hunter McDonald, who has been with the road since 1878, recently as assistant engineer, has been made superintendent at Fayetteville. Mr. M. Anderson, appointed superintendent of the Jasper branch, has been with the road 30 years, serving as fireman and locomotive engineer. He has had charge of the Jasper branch three years. Mr. Edward Brown, appointed superintendent of the Centreville branch, has had supervision of it for a number of years. He commenced as a locomotive engineer on the road 30 years ago.

The Capitol Manufacturing Company, of Chicago, have been awarded a prize medal for their wrenches at the Paris Exposition.

The Scarritt Chair Company, of St. Louis, Mo., have recently furnished seats and chairs for service on fifty coaches, for roads in four foreign countries.

The Chesapeake & Ohio have recently added to their equipment some handsome coaches, equipped with the celebrated Scarritt chairs, magnificently upholstered in olive plush.

The Samson Cordage Works, of Boston, are increasing their product of solid braided cord very fast, and have been filling large orders to railroads for bell cord, air brake cord, bell cord couplings, etc.

The Davis Spring Plate Company., of Wilmington, Del., report business as very satisfactory. They furnished during the past twelve months enough of their steel spring plates for 80,000 freight cars, and judging from the orders they have on hand they expect to increase that number very considerably during the next twelve months.

Advices have just been received from Paris that J. A. Fay & Co., of Cincinnati, Ohio, have been awarded the Grand Prize over all competitors for the best wood-working machinery at the great Paris Exposition. This is a just tribute to American enterprise, skill and workmanship, and as the award is made in the face of the strongest competition from the French and English manufacturers, we take pride in such an occasion for our hearty congratulations.

The partnership heretofore existing under the name of Whittlesey & Wright, wherein George P. Whittlesey, of the City of Washington, D. C., and D. Pratt Wright, of Berkeley Springs, W. Va., were co-partners, is this eighth day of August, 1889, dissolved by mutual consent. George P. Whittlesey,
D. Pratt Wright.

The affairs of the firm will be adjusted, and the business continued by George P. Whittlesey.

The Standard Journal Bearing Company has been formed in Chicago to manufacture car and engine bearings, locomotive bells, brass and bronze castings, Babbitt metals, etc. President and Treasurer, Mr. T. J. Tierney, of the well-known firm of T. J Tierney & Co.; Vice-President, Mr. F. W. Thayer, formerly of the Thayer Manufacturing Company (car brasses) of Milwaukee, and General Superintendent, Mr. Geo, A. McArthur, for the past three years Superintendent of the Hewitt Manufacturing Company (car brasses),

Mr. Henry T. Bartlett, 200 Lewis street, New York, dealer in mahogany, fancy woods and veneers, has recently brought from Indiana a remarkable specimen of black walnut, and, doubtless, the largest burl ever brought to New York. The burl extends entirely around the tree, and at its greatest circumference is thirty feet, while judging from the bark indications, an almost infallible sign, the wood beneath is beautifully marked with birds' eyes. When cut, this solid burl, of 9,800 pounds, will yield between 35,000 and 40 000 feet of veneers.

In the suit, in the Eastern District, of the Bridgeport Wood Finishing Company vs. New York Wood Finishing Company and others, for infringement of the celebrated Wheeler patent covering the use of ground silex, quartz, feldspar, etc., in wood filler, subpœnas have been served on all the defendants, citing them to answer on the first Monday of November, 1889.

Application for an injunction, during the pendency of the suit, will be made to the court.

The Bridgeport Wood Finishing Company, New Milford, Conn.

Mr. Frank H. Andrews, of West Thirty-fouth street, New York City, is very busy in all the branches of his business, more especially in the "car heater" department. In spite of the agitation of the question of heating cars by steam, he is receiving large orders for the Baker Heater Company for the "Perfected Baker Heater." He is also receiving large orders for the street-car heater, one of which was on exhibition at the street railway convention recently held at Minneapolis, Minn., and attracted considerable attention, quite a number being ordered by the different companies represented there, one company ordering as many as 30 heaters, although they never had any in use before.

James Spear of Philadelphia, manufacturer of Car Heaters and Ventilators, is unusually busy. The question of heating cars by steam seems to have no effect upon his business. Many leading Railway Companies still use his heaters exclusively, and a number of others are using them as alternates or substitutes for steam. These heaters and ventilators have been long and favorably known and are reliable in the coldest climates; they are extremely simple and easy of management. Their C Pattern heater is used very largely by railroad companies who are experimenting with steam to provide against blizzards or any failure of steam heat. It is a ventilator as well as a powerful heater, receiving the cold air at the top of the car and discharging it on the floor thoroughly heated, yet fresh and abundant, the whole taking up a very small space and not interfering in the least with steam fixtures.

The growth of the Westinghouse Machine Company's business still continues. During the past five years its buildings have been extended from the square in Pittsburgh originally occupied by the Westinghouse Air Brake Company until they now cover two and one-half blocks of contiguous property. Machinery has been added (much of it quite recently) until now the limit has been reached and there is no space for more. No additional property is available in the vicinity, and to keep pace with the constant growth of the business the company is engaged in erecting a three-story warehouse for finished engines, repairs, etc., which will be provided with steam hoists, overhead cranes and all known appliances for the quick and economical handling of heavy weights. In addition to this, the company is now taking on a complete new force of workmen, so that the establishment will henceforth be operated continuously day and night.

The Van Dorston Cushioned Car Coupling Equipment Company, at Philadelphia, has acquired a large property (adjoining the tracks of the Philadelphia & Reading Railroad) on Reaney street, in the city of Chester, Pa., and contracts have been entered into for the erection of suitable buildings for the manufacture of the Van Dorston cushioned coupler, cushioned draft gear and new central buffer for freight cars. These shops will be rapidly pushed to completion and occupied by this company at an early date. At the present time the company is busily engaged in fitting up both passenger and freight equipment for the Philadelphia & Reading Railroad Company with the Van Dorston coupler and its other appliances—notably, cars running in the fast passenger service between New York and Washington; also the private car of General Superintendent Sweigard. Negotiations are also pending between this company and several other prominent railroad lines for the equipment of their rolling stock with the coupler and other appliances manufactured under the Van Dorston patents.

In King's Handbook of Boston for 1889 we find a good illustration of the large establishment of Messrs. John L. Whiting & Son, one of the most substantial concerns of that city. The publication named also contains the following sketch of the firm, which we reproduce with pleasure:

"John L. Whiting & Son, of Boston, are the leading brush manufacturers of the United States, and their great six-story brick factory building at the corner of High and Purchase streets, in Boston, has probably the capacity of any other four establishments combined. The house was founded by the senior partner in 1864, and is said to be the most extensive in its line of goods in the world. In 1884 the firm erected the building now occupied by them exclusively. It has a floor surface of 60,000 square feet, and is complete in all its appointments. The old brush makers assumed that the process in use in the manufacture of staple brushes had been stereotyped, and that further improvements were almost impossible; but, notwithstanding this, Mr. Whiting effected radical improvements by bringing into use ingenious machinery and original processes, the results of which were a material reduction in the cost of nearly all the lines of staple brushes. This firm has the largest corps of skilled brushmakers in the United States, and a great portion of them having been in their employ many years. This fact, together with the fact that they carry at all times an enormous quantity of all kinds of stock, guarantees to their customers almost perfect uniformity in the excellent quality of their goods, which they have invariably maintained from the start. Their customers reach out to all the borders of this country, and into many foreign lands. The firm to-day comprises John L. Whiting, the founder; Wm. S. Whiting, and Lew C. Hill. They have received many first medals in contests with the brushmakers of the Old and New Worlds, including two gold medals at the Massachusetts Mechanic Association, several awards at the American Institute, and the Centennial Exposition at Melbourne."

The annexed cut represents a newly-designed extra heavy tenon machine, with double heads and two copes, especially presented to the trade as by far the best tenon machine now in the market, and having superior advantages and conveniences for car builders, planing mills and other general wood-workers.

The frame is cast whole, the main part being on a pedestal, and it stands more solidly than a machine on which the legs are bolted.

It will cut tenons from ¼ to 7 inches long, and the heads can be adjusted to any thickness.

The mandrels are of steel, and run in self-oiling grooved boxes, and the lower half of box being cast on the mandrel or yoke, makes a very reliable bearing. Tightening on the caps or boxes takes out all end motion or vibration on the heads, thereby causing them to do smooth and perfect work.

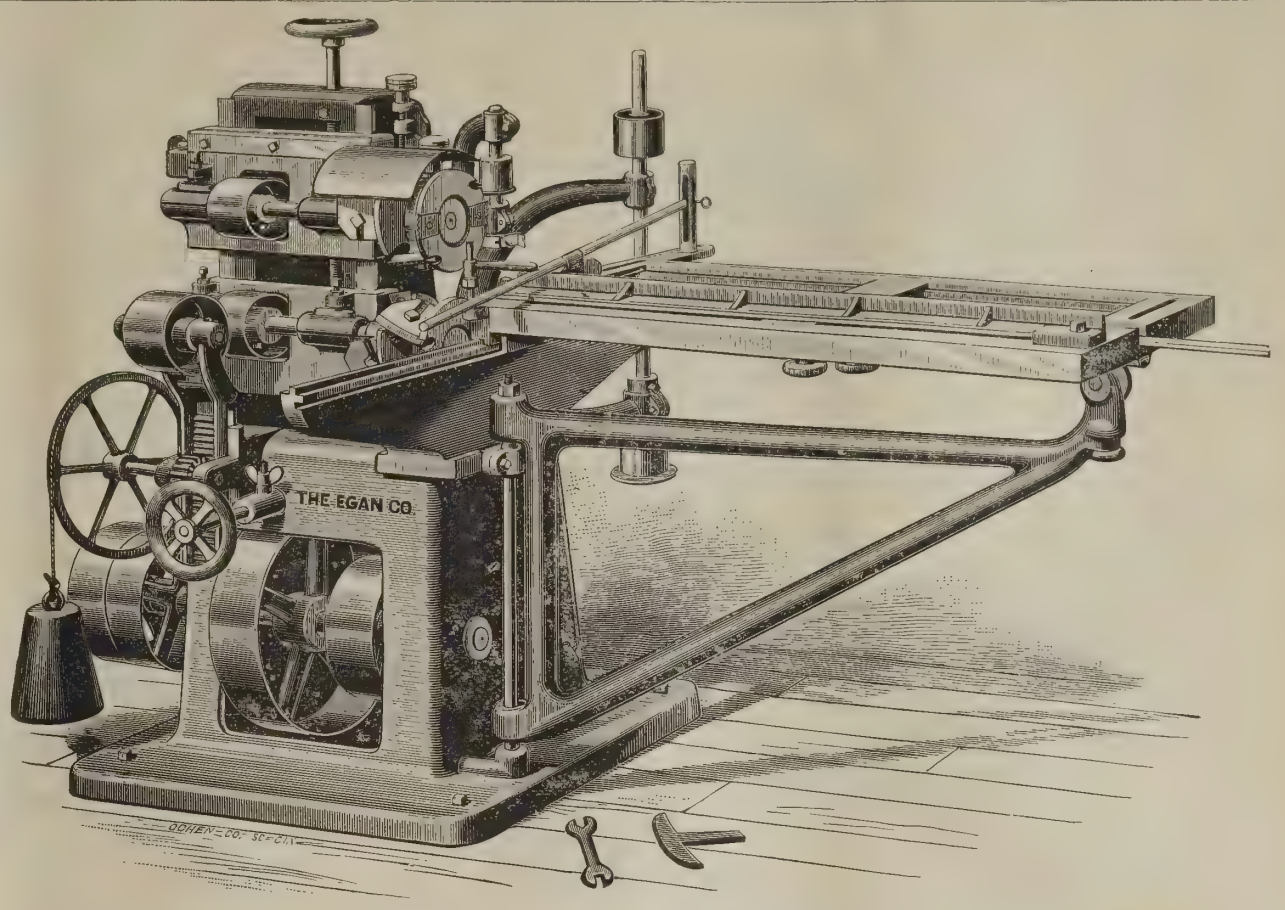
The table is light, and very stiff and strong. It is easily and quickly handled, and has the extension bar with two stops adjustable to any length of tenon. The swinging support for the outer end of table is of the latest improvement, and is arranged so that the operator can walk clear beyond the heads in cutting the tenon; on wide tenons this is a great advantage, as the operator can follow up and does not lean over so much.

The table is gibbed on under side of slide next to frame, and by no possible accident can it be thrown into cutter heads, and the outer end being on a swiveled roller, the motion is far easier and steadier than made in any other way.

The upper cutter head, with its mandrel and frame, can be moved laterally so as to cut longer tenons than the lower if wanted. Saw spurs are used on heads, and the shear cut made by these heads is first-class. The cope heads can be adjusted both ways and are driven with very long belts, thus preventing all slippage or falling off of belts.

The main driving belt runs between boxes and has full clearance, and can be made endless, as the tightener holds belt always taut, and keeps it so closely hugged to spindle pulleys that there is no slipping, even when doing the heaviest kind of cutting.

For further information, address the manufacturers, the Egan Company, Cincinnati, Ohio.



NEW NO. 3 TENON MACHINE.

(*Solid Frame Swinging Support to Table*). *Double Heads and Copes.*

The Eberhardt Patent Drill Press.

The accompanying engravings, embracing Figs. 2, 3 and 5, present to our readers illustrations of the Eberhardt patent drill press as made by Gould & Eberhardt, of Newark, N. J.

Each illustration, though similar as to the general principle of their recognized novel-featured drills, represents each machine fitted with different appliances for performing work, each possessing its own individual advantages.

Fig. 2 shows the drill press with Eberhardt's Patent Automatic Tapping Attachment applied, together with a compound traverse table. This tapping attachment is truly a labor-saving device. As will be seen it is applied directly alongside the main spindle. The table is held parallel with the face of the column, by placing two dowel pins, one at either end of the raising and lowering rack; thus one or a series of holes may be bored and tapped rapidly with very little shifting of the work. The top slide of this table is moved by rack and pinion, which permits quick adjustment. Either bottoming or through holes may be tapped.

After it is set and started it will go the proper depth, reverse and run back, and is ready again for the next hole. This is done immediately after. The hole or holes are drilled without taking the drill out of the spindle or loosening the work on the table.

It *does tap* the holes *true* and *quick*.

It is something in which no reverse belts are needed.

No delicate mechanism is to be adjusted.

No special taps are required. No change of speed from speed drilling to tapping. It is capable of tapping from 0 to 1¼ in. hole in cast iron and will do the same in wrought iron or steel, using two taps; smaller sizes can be done with one tap.

Fig 3 illustrates their regular drill press with a compound traverse cluck. The top slide is 16 inches square, and has a movement of 12 inches; the lower slide moves 18 inches at right angles. The slots do not cut clear through from end to end of slide, but are tied together by a rib on each, only leaving a small lower portion of the slot to cut through as shown in cut. This practice, we believe, is something new, and certainly very essential, these slots all being surrounded by a 2-inch groove, which serves to hold all oil, chips, etc. This chuck in connection with the drill, proves itself a very serviceable tool, and for a large variety of work substitutes an expensive profiling machine or upright miller.

Fig. 5 illustrates the regular drill press with an adjustable square table in place of the usual round table. These are made with either one slide, as shown in cut, or with two slides having two movements. The advantages of this slide are apparent.

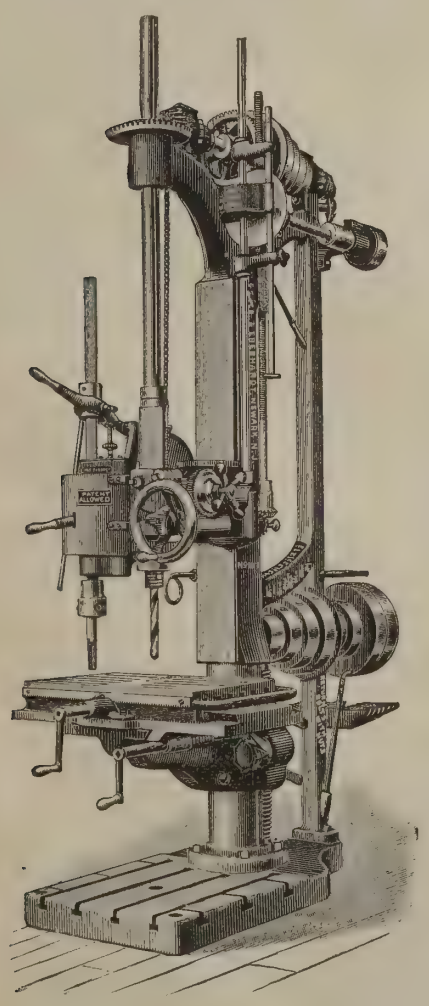


Fig. 2.

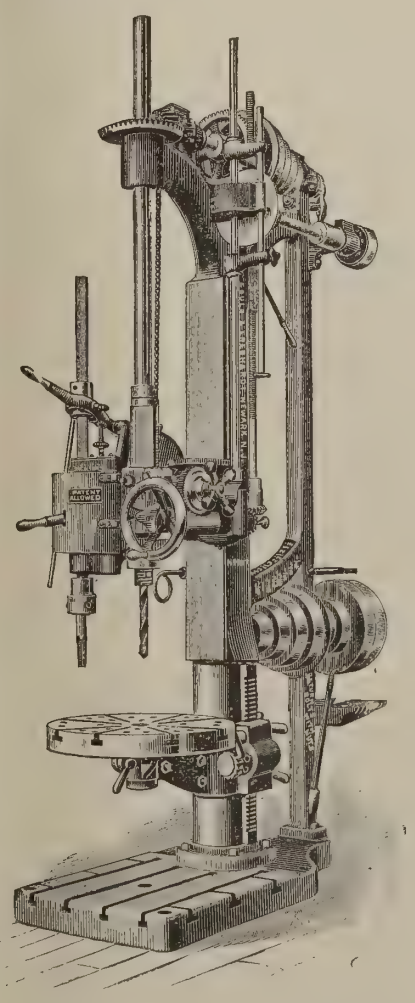


Fig. 3.

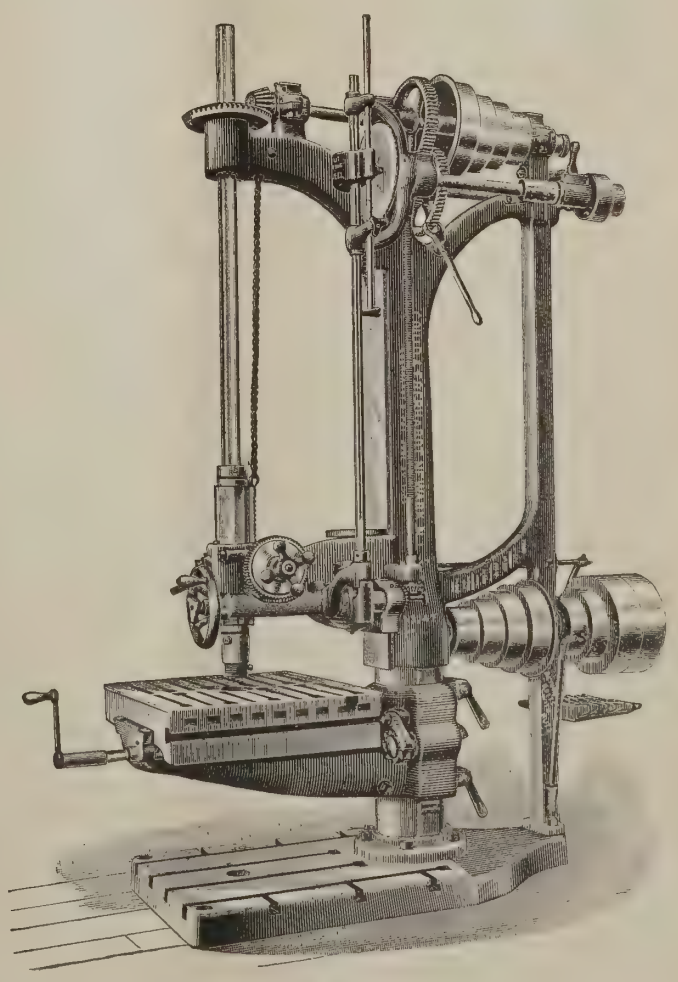


Fig. 5.

THE EBERHARDT PATENT DRILL PRESS.

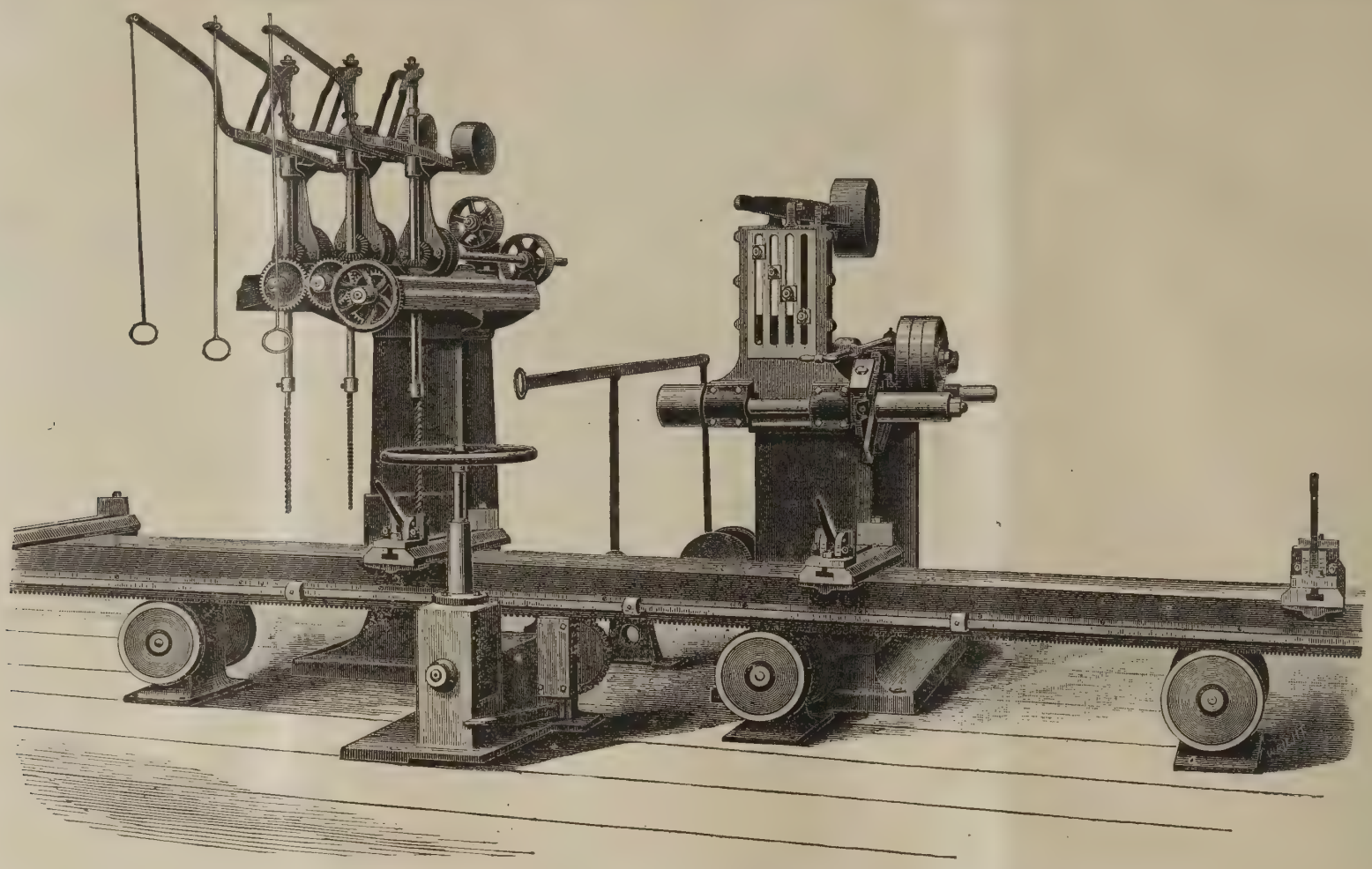
The Indianapolis Car Works have been awarded the contract to build 900 coal cars for the Pittsburgh & Western. Two hundred of these cars are to be delivered within 30 days and the rest by Feb. 1, 1890.

The St. Charles Car Company, of St. Charles, Mo., have shipped eight cabooses for the Rio Grande Western and four cabooses for the Mexican Central.

The Great Northwest Central has purchased three heavy locomotives and 50 platform and 50 box freight cars, which have been sent through to Brandon, Man.

The "Perfection" Oil Can.

One of the latest inventions of the celebrated Jno. Rau is the "perfection" oil can, which is rapidly coming into general use among engineers and machinists all over the country, and is without question one of the most economical, durable and satisfactory cans on the market; in fact it is guaranteed by its manufacturers to save its cost each week in time and oil. It has been indorsed by leading manufacturers all over the country and by the National Governments. Any further particulars will be furnished by the Rau Patent Oil Company, 42 and 44 Michigan street, Chicago.



CROSS-GAINING AND GROOVING MACHINE AND THREE-SPINDLE VERTICAL BORING MACHINE.

This combination consists first of a carriage or table as long as the longest timbers to be operated on, mounted on roll stands so as to be rapidly and easily moved, either by power or hand, in front of the gaining or boring machines as required. This carriage is provided on its top with bolsters, carrying suitable clamps for bolting the material while in process of operation, and on its front edge with a line of stops that when once set indicate the point to be gained or bored. By this means work without being laid out can be easily duplicated.

Second.—The gaining machine of the latest construction, heavy and substantial, has a movement of 24 inches forward and backward, and a vertical one of 16 inches, arranged with a system of stops which, when once set for a particular kind of work, regulate the depth of gain, and laying out is not required for duplication. The cutter heads of this machine are fitted with spurs for cutting the shoulders, and knives by which the wood between is removed, and will cut equally well on either its forward or backward movement.

Third.—The three-spindle boring machine is of new design and fills all the requirements that have been found wanting in other machines. The spindles have a movement of 24 inches across the table, and are so arranged that all three or any two can be moved at once, or each one separately, as desired. Each boring spindle can be set at an angle for boring angular holes for truss rods, etc.

Both of these machines are set alongside of the table first described and as shown in the cut. The object of this arrangement is to save handling by performing all these various operations on a piece of timber when once in position on the table.

Details Supplied.—One gainer head, five auger bits, 15-inch twist, two countershafts and full set of cast steel wrenches.

For further particulars address the manufacturers, Berry & Orton Company, Philadelphia, Pa.

The Pullman-Cloes Manufacturing Company claim the following advantages for their car door;

1st. The rolled plate to which the door is hung forms a complete weather strip, thereby saving expense as well as being far more efficient than is the ordinary plan of construction.

2d. The hanger attached to the car door is rolled to correspond in form identically with that of the weather strip, and thereby constituting a perfect channel for the movement of two balls upon which the entire door rests.

3d. The balls are chilled, and constant service experimentally for three years on several railway systems showed no wear whatever.

4th. "Stops" are so placed in the "hanger" that the balls are kept equi-distant and so arranged that the door cannot be sent forcibly against the post, thus averting damage in case of sudden shock.

5th. The door is anti-frictional in all circumstances, whether under vertical or lateral pressure, and the construction is such that it is impervious to weather, thus obviating the difficulty and annoyance caused by frost and ice, and cannot be detached from the car under the severest service.

6th. By means of a peculiarly adapted device attached to the rear edge of the door it is so pressed against the post or side of the car as to render it absolutely proof against sparks or cinders, which is a desideratum fully appreciated by all railway officials.

7th. The first cost of the Pullman-Cloes door is scarcely above that of the door ordinarily used by railway companies, and is relatively less than any other patented device that has thus far been tested.

8th. So far as relates to ordinary "wear and tear" in service, there is absolutely no expense for repairs, inasmuch as there is no detail touching its construction that can break or in any way become disarranged.

9th. It can easily be seen that the construction of this door is such that it can be so adjusted as to swing outward from the bottom at any angle, as nothing can dislodge it from its connection at the weather strip. This has been proven of special efficiency when in service upon stock cars.

10th. Many freight car doors have failed of service in instances where the roof has "sagged." This is impossible with the "Pullman-Cloes" door.

The Tripp Manufacturing Company, of Boston, report that their anti-friction roller bearing is quite a success and is meeting with the approval of all those who have used it. The Chicago Arc Light and Power Company, speaking of the one they have in use on their 6-inch. shaft, which is 50 feet long and runs at 280 R. P. M., say that there is no sign of heating, and that the friction seems to be reduced to a minimum.

The Ajax Metal Company, of Philadelphia, Pa., finding that their old foundry was not large enough for their rapidly increasing business, have recently erected a large building 80 feet wide by 222 feet deep, and fitted it up with all the modern improvements known to the foundry business. They have twenty furnaces, capable of turning out from 12,000 to 15,000 pounds of metal per day. Even with this large increase in their capacity, they have orders on hand that will keep them busy for the next sixty days. Their new foundry is at 46, 48, 50 and 52 Richmond street, Philadelphia.

The Schenectady Locomotive Works have lately added to their shop equipment a heavy planer specially designed for frame work. It takes in work 6 × 6 feet and has a travel of 26 feet and carries four heads. They have also got a new steam hammer for frame work. Both tools were made by Bement, Miles & Co., Philadelphia.

Our Directory.

We note the following changes since our last issue. Our readers will do us a great favor by giving us prompt notice of any changes that may come to their knowledge of any error that may be noticed in our list.

Atlantic & Danville.—F. C. Robinson, master mechanic, has resigned on account of ill health. V. H. Stevens has been appointed superintendent to succeed A. D. Bateman.

Chicago, Rock Island & Pacific.—General Master Mechanic T. B. Twombly having resigned and asked to be relieved, George F. Wilson has been appointed acting general master mechanic, pending action on such resignation.

Chicago & Northwestern.—Mr. Charles W. Hayward has been appointed purchasing agent, in place of Mr. R. W. Hamer, resigned.

Chicago, Santa Fe & California.—Mr. C. O. Wheeler has been appointed general superintendent, with headquarters at Chicago, in place of Mr. D. J. Chase, resigned.

Central R. R. and Banking Company of Georgia.—Cecil Gabbett has been appointed general manager, to succeed Mr. H. S. Belknap.

Detroit, Lansing & Northern.—Mr. Thomas Butterworth has been appointed master mechanic, with headquarters at Muskegon, Mich.

Evansville, Terre Haute, Peoria, Decatur & Evansville, and Evansville & Indianapolis.—W. D. Ewing, general manager, has resigned.

Fort Wayne, Cincinnati & Louisville.—William B. McPhail has been appointed master mechanic, vice T. H. Haberkorn, resigned.

Fairhaven & Southern Railroad Company.—Mr. Alex. McLean has been appointed master mechanic, with office at Fairhaven, Wash. Ter.

Jacksonville Southeastern Line.—W. J. Hemphill has been appointed superintendent of motive power and machinery, and will have charge of motive power and machinery and car departments.

Jacksonville Southeastern Line.—D. W. Rider, superintendent, makes the following announcement in a circular dated Jacksonville, Ill., Oct. 1: "Mr. W. J. Hemphill is this day promoted to the position of superintendent of motive power and machinery, and will have charge of motive power and machinery and car departments of these lines."

Kentucky Union.—T. B. Slade to be superintendent; J. M. Carr to be master mechanic.

Los Angeles & Pacific.—Herman Silver has been appointed receiver of the road, to succeed W. T. Spillman.

Montana Union.—William H. Baldwin has been appointed general manager, with headquarters at Butte City, to succeed Robert Law, superintendent, resigned.

Nashville, Chattanooga & St. Louis.—J. W. Thomas has been appointed assistant general manager of the road, with office at Nashville, Tenn. The following appointments have also been made: M. J. C. Wrenne, General Superintendent; Hunter McDonald, Superintendent of the line between Decherd, Columbia and Huntsville, with headquarters at Fayetteville, Tenn.; M. Anderson, Superintendent of the Jasper branch, with office at Jasper, Tenn.; Edward Brown, Superintendent of the Centreville branch, with headquarters at Dickson, Tenn.

Ohio River.—Mr. Alexander Laird has been appointed master mechanic, with headquarters at Parkersburg, W. Va.

Ohio, Indiana & Western.—J. A. Barnard has been appointed general manager of this road to succeed Charles Henderson, resigned.

Pittsburgh & Western.—J. A. Quinn has been appointed master mechanic, vice J. H. Agnew.

Philadelphia, Wilmington & Baltimore.—Master Mechanic H. D. Gordon has resigned. He is succeeded by Mr. C. G. Turner, general foreman of the Wilmington shops. Mr. Gordon is to take charge of the Juniata shops of the Pennsylvania at Altoona.

South Carolina.—John M. Smith to be master of machinery, office at Charleston.

Saginaw, Tuscola & Huron.—M. V Meredith has been appointed superintendent, to succeed Robert Laughlin.

St. Joseph & Grand Island.—Mr. E. H. Dawson, Jr., has resigned his position as master mechanic to enter the service of the Union Pacific at Ellis, Kan.

Terre Haute & Peoria.—W. G. Van Buskirk has been appointed master mechanic, with office in Paris, Ill., to succeed F. Young, resigned.

Employment.

WANTED—Situation as foreman boiler-maker in a railway shop or locomotive works. Best of references. J. T. Connelly, Box 166, Huntington, W. Va.

SITUATION WANTED as blacksmith, 20 years' experience. General workman on locomotives and stationary engine work. Address J. W. C., Box 514, Huntington, W. Va.

WANTED.—By a member of Master Mechanics and Master Car-Builders' Associations, position in motive power department, or would make engagement with some one in railway supply business. No objection to travel; 24 years' experience in railroads; first-class references. Address S. A., care of this journal.

WANTED.—Well known traveling salesman to solicit the adoption of the Butler Drawbar Attachment by railroad and car companies, for which service they may take either an interest in the business or receive a commission. Address W. W. Hayward, Secretary Butler Drawbar Attachment Company, Chicago, Ill.

NATIONAL CAR AND LOCOMOTIVE BUILDER

DECEMBER, 1889.

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The Staten Island Rapid Transit Railroad are in the market for 10 new passenger cars.

The New York, Susquehanna & Western are in the market for six new passenger cars.

The Philadelphia & Reading have ordered 50 new passenger cars from the Pullman Company.

The Big Fours have lately ordered a handsome train of five cars to be built by Barney & Smith.

The Georgia Central have lately ordered 22 new passenger cars and 1,000 freight cars from the Ohio Falls Car Works.

The New York Central have ordered a number of passenger cars to be equipped with the Frost system of heating and lighting.

The Cincinnati, Jackson & Mackinaw Road has contracted with the Michigan City (Ind.) Car Works for 500 box cars, and has also given orders for five new locomotives.

The output of locomotives at the Baldwin Works, in Philadelphia, during October was 104. Orders in hand warrant the assumption that their output during the coming year will be considerably over 1,000 locomotives.

Don't waste your time talking spitefully to the station master when you find that you have missed the train. Buy a pint of peanuts and scatter the shells all over the station floor. That is about the only way in which you can get even with the company.

The Chicago & Northwestern are applying to their passenger cars a brake piston travel recorder designed by Mr. Schroyer, superintendent of the car department. It consists of a brass graduated scale secured to the cylinder head, the scale being moved by the piston.

C. M. Ward was appointed general Manager of the South Carolina Railway by Receiver Chamberlain, in place of Col. John B. Peck, who has been connected with the road for the last 10 or 15 years. Mr. Ward has been superintendent of the Pittsburgh Junction Division of the Baltimore & Ohio system.

The first statue erected in this country to a workingman will soon be unveiled in Sacramento. It is in honor of E. J. Stevens, late master mechanic of the Southern Pacific, who had for years been in charge of immense railroad shops in Sacramento. The funds were contributed entirely by workingmen.

The Boston & Albany people have made a protracted experiment in lighting trains with electricity and they have now decided to return to the ordinary methods of car lighting. This is very much to be regretted. The company had two full trains lighted by electricity, but it was found to be more expensive and less reliable than oil.

During the year ending Sept. 30 the four lines of elevated railroads in this city carried 179,497,433 passengers, an average of 493,000 in each day of the year. Of no other railroad system in the world can this be said. Since the road was first opened it has transported 1,202,920,332 persons, which is nearly equal to the estimated population of the earth.

Passengers on the Midland Railway of India are cautioned to close their windows on nearing a certain bridge. Bees have taken up their abode in the masonry in spite of the best efforts to dislodge them, and they regard the trains and the passengers they carry as their mortal enemies. The engineers, riding on the open English style engines, must have a lively time.

L. F. Brigham, general purchasing agent and storekeeper of the Long Island Railroad, has resigned to accept a similar place with the Philadelphia & Reading Coal and Iron Company. L. G. Hubbell, chief clerk in the general freight office in Long Island City, will be made purchasing agent, and Jeremiah M. O'Conner will be promoted from assistant purchasing agent to general storekeeper.

George B. Carr, general superintendent of the Columbus, Hocking Valley & Toledo Railroad; M. P. Booth, superintendent of the Hocking Valley Division, and W. T. Seymour, supeintendent of the Toledo Division, tendered their resignations to President Waite. The cause assigned for the resignations is that they could not properly conduct the departments under the policy of the present management. A few other resignations from minor positions were handed in.

The Louisville & Nashville Railroad Company have just contracted with the Rogers Locomotive Works for 10 consolidated freight engines and 10 switch engines of heavy grades. The company are regularly receiving shipments on current contract with the locomotive works of engines which are going out at once on the roads. At the last directors' meeting $3,000,600 were appropriated for such betterments, and the management are determined to put the rolling stock in first-class condition.

President Eckstein Norton, of the Louisville & Nashville, says: We have received 20 new locomotives since July 1, 10 consolidation and 10 switch engines, and have contracted for 20 more consolidation engines to be delivered within the next few months. On July 1 we had contracted for 1,250 cars that had not been delivered, and have since contracted for 650 more, all to be delivered by Jan. 1, making a total for the six months of 1,900 cars, 500 refrigerator cars, 500 box and 900 coal and ore cars.

An engineering firm at Essen, Germany, which make corrugated flues, have recently applied two large flues, one set above the other, as furnaces for a locomotive. The change slightly increased the fire-box heating surface of the engine, and steam was found to be supplied more freely than before the change, but the engine used more fuel. No special advantage appears to have been derived from the change, for it is doubtful if corrugated flue furnaces would last as long as the ordinary fire box.

"Is Chauncey Depew in?" asked a man carrying an ancient carpet-bag one day early in the week, as he approached a gateman in the Grand Central Station. "No, sir," replied the gateman. "Ain't down from the house, hey?" "No, he hasn't got back from Europe yet." "Ain't in the country a' tall, hey? Well, well, that's too bad—I wanted to see him 'bout one of my cows that his pesky road killed and ain't done nothing about it yet, but I reckon I can't this time. First time you see him after he gets back, jess tell him that old Hank Wakely was in to see him 'bout that cow, and that he'll be down again in November. Good mornin'—an' you might jess hint to him that I'll never take less 'n $60—not a red cent less 'n sixty."

The Lehigh Valley Railroad Company intends to have a fire company of its own on wheels. It is now having a locomotive in its shops in South Easton, Pa., supplied with a patent arrangement by which it can help extinguish any fire that may occur along the road. The arrangement is being attached to the rear part of the engine, will be worked by an injector connected with the tender, and has couplings for two lines of hose. The power afforded by the injector is expected to throw a stream through 300 feet of hose and a 1⅛-inch nozzle a distance of 150 feet. Many fires are started along the road in the fall and spring by sparks from the locomotive igniting dried grass and leaves. These fires sometimes communicate with barns and houses. When a fire of this kind occurs, the arrangement is to telegraph for the "fire company on wheels" and have it extinguished.

The Pennsylvania Railroad Company are making experiments with a fire-proof railway car. The distinctive feature of the car is that it is all iron or steel. The roof, sides and ends of the car are made of boiler-plate riveted together. The car is somewhat in the shape of a horse-shoe, the round part being the top. In the bottom are several steel girders placed in cement, much the same as in Pullman cars. Along the sides is an array of windows, precisely similar to those of ordinary passenger coaches. The top of the car is destitute of heavy roof and ventilating arrangements that are seen on ordinary cars. It is said that ventilation is secured by pumping air into the car through pipes. These pipes in winter are arranged so as to furnish warm air. It is claimed that it will not burn, will last forever, and will not telescope or break up in a collision.

Mr. C. C. Wheeler, for many years general freight agent, traffic manager and assistant general manager of the Chicago & Northwestern, and at one time general manager of the Atchison, Topeka & Santa Fe, has opened an office in the Phenix Building, Chicago, and will undertake the examination of railroad properties, report on the value of projected lines, and give estimates of the cost of same. Mr. Wheeler examined the Wisconsin Central in the interest of the Northern Pacific previous to the latter's contract with that road.

The New York Equipment Company, it is stated, has a contract from the Montgomery, Tuscaloosa & Memphis Railway Company for the equipment of the road. There will be seven eight-wheel locomotives, valued at $8,500 each; eight ten-wheel locomotives, valued at $9,000 each; eight first-class passenger cars, valued at $4,500 each; six second-class passenger cars, valued at $4,000 each; five baggage, mail and express valued at $3,100 each; five cabooses, valued at $900 each; 200 flat cars, valued at $325 each; 150 box cars, valued at $440 each; 100 gondolas, valued at $500 each. The total value of the equipment contracted for is $381,500. By the provisions of the contract the locomotives are to be built at Dunkirk, N. Y., the passenger equipment at Hegewisch, Ill., and the freight cars at either Anniston or Decatur, Ala. The contract requires that all the equipments shall be first-class and furnished with latest improvements.

The Delaware, Lackawanna & Western Railroad Company has set apart for the use of its employés half a dozen rooms in the second story of the new passenger station in Hoboken. They comprise a reading room, supplied with all the leading dailies, scientific, literary and railroad periodicals; parlor for correspondence and committee meetings, hall for meetings, lectures and entertainments; a dining room where men can lunch who are unable to reach home, and fully equipped bath and wash rooms. A regular course of entertainments and lectures is to be given under the auspices of the Railroad Branch of the Y. M. C. A., which has charge of the rooms, and educational classes will be held in several branches. The Executive Committee includes representatives from every branch of the railroad service, Assistant Superintendent F. J. Griffith being chairman.

The Fowler Steel Wheel Company, Chicago, has lately got in operation their new furnace, which operates on the Robert process, for making cast steel for car wheels. Several castings were satisfactorily made, and with the exception of the facilities for handling the material the apparatus is in good working order. Improvements are being made daily, and all of the machinery is being put in condition for regular business. The shops are located near Burnside, on the Illinois Central Railroad, not far from the Nickel Plate shops. Several large buildings contain the machinery for rolling the wheels, the furnaces for heating, pits for annealing, blowing engines, stationary boilers, cupola, converter, and the few machine tools. The men in charge of the work are gradually becoming used to the new process, and each succeeding blast is better than the previous one. The firm is now in the market for orders, and has laid out the plant for a capacity of 200 wheels per week.

Mr. W. K. Vanderbilt is giving considerable attention to the Lake Shore. He is thoroughly familiarizing himself with the most recent features of Lake Shore traffic and the plans for physical betterments which Mr. Newell has devised, and is giving these plans a cordial support. A striking example of this is that the Lake Shore has ordered 1,500 additional box cars, and that the contracts for 1,400 more cars will be made for delivery next spring. This will make about 4,500 Lake Shore cars ordered this year, a larger number than in any previous year. But the present heavy volume of business demands it. The cost of these cars, together with that of the locomotives that have been ordered, will be about $1,500,000, an immense sum to put into equipment in one year, about three per cent. on the stock. With the extensive improvements that have been made in building 34 miles of double track, in cutting down grades, etc., the total betterments for the year will amount to fully $2,000,000—a magnificent record.

The Pittsburgh, Cincinnati & St. Louis road has just received from the shops at Altoona, Pa., nine new passenger locomotives known as "class O." They are 8-wheel engines, weighing 99,000 pounds each, with 68-inch driving wheels. Speaking of the new locomotives, a Pittsburgh exchange says: "The most striking difference in these engines over the old ones is in the boiler and the position of the steam dome. The boiler has a square and enlarged end (Belpaire fire-box), giving increased steam pressure, and, with an increase in the size of the wheel, more speed is attained. The steam dome is set forward further on the boiler, and an auxiliary dome provided for supplying the whistle and safety valves with steam, as well as the other valves inside of the cab. Another improvement, small in itself, but important, is in the sand pipe. An oblong instead of a round hole is provided, in order to secure a better distribution of sand over the track, the orifice being covered by a hood to keep the wind from blowing the sand away.

NOTES OF THE PARIS EXHIBITION.

Editorial Correspondence.

There was once a time when collecting together the industrial and natural products of many lands into a great exhibition was looked upon as a promising means of bringing about a condition of universal peace and harmony; when the lion would lie down beside the lamb, and other strange bedfellows of the human species would repose together without kicking. Many good persons regarded the first great industrial exhibition which was held in London in 1851, as the beginning of the Millenium, but it proved to have little effect in subduing or controlling human passions, yet it performed very useful services to mankind, and all succeeding efforts of the same kind have had an excellent educational effect if nothing more.

The great Exposition Universelle just closed at Paris has proved the greatest of all exhibitions, and it is to be hoped that its influence for good, will exceed that of all others in proportion to the greater magnitude of the affair. Many of our readers may not be aware that the exhibition was held to commemorate the centenary of the revolution of 1789. That revolution was effected amid deplorable excesses and entailed untold suffering and misery; but with all its horrors, it introduced into France a condition of comparative happiness and prosperity. Liberty, equality and fraternity, the watchwords of the most violent revolution the world has ever seen, were found compatible with the perpetration of terrible barbarities; but the worst barbarities of the impassioned populace, were as nothing compared with the horrible and nameless practices inflicted on a patient people for centuries before 1789, by infamous rulers.

The effete monarchies of Europe did not, as a rule, respond cordially to the invitation of the French Republic to help in commemorating the centenary of the revolution that did a great deal to put the influence of monarchs and princes at a discount. The exhibition has been an unmitigated success, but no thanks were due to the friendly co-operation of foreign princes and potentates. In view of the aid and sympathy which the patriots of France gave to American patriots a century ago when they were struggling to form a nation, it looked a little shabby on the part of the United States government to be so meagerly represented at the Paris exhibition. It looked as if our people sympathized with the disgruntled monarchies already mentioned.

If our people could stand the giving of the snub with comfort, it is all right, for the French do not appear to have suffered any. They have had the biggest exposition yet held, and no thanks to the rulers of other countries. If the rulers stood aloof, private individuals and public companies took care to be well represented. The natural and manufactured products of nearly every country under the sun were profusely displayed in the sections set apart for them.

The exhibition, as a whole, was bewildering in its immense magnitude. Unless a visitor was there for a month, devoting the greater part of each day to examining the various sections, he could not do the place justice. In rambling around the exhibition buildings and grounds, a visitor was soon impressed with the great magnitude of the display, but the critical eye also became aware that something much higher than a mere magnificent collection had been aimed at. The writers and speakers, who dilate on our coming exhibition of 1892, are constantly expressing the desire that our great country should astonish the world by displaying the *largest* exhibition ever inflicted upon mankind. It will require stupendous efforts to surpass the French in this respect, but if our big show is to make a favorable comparison with the French exhibition, something more than mere magnitude of the place, the buildings and the exhibits must receive profound consideration. The French not only got together the finest collection of products ever exhibited, but by some surprising means they succeeded in getting the owners of exhibits to combine in giving the best possible artistic effect to their united collections. There was very little to be seen of the vulgar desire of John Smith to make his exhibit more ostentatious than that of Thomas Brown. The rule appeared to be for Thomas, Richard and Henry to combine their exhibits with the view of producing a harmonious effect. By this means the exhibition was made not only the largest, but the most artistic display ever held.

My attention was principally devoted to Machinery Hall, and the products to be found therein. The hall itself is a most striking structure, and is probably the largest building in the world covered by an arched roof. The size of the buildings is immense, yet the proportions are so admirably designed that the beholder is some time in realizing the great magnitude of the dimensions. The hall is 1,350 feet long, 495 feet wide, and 160 feet high, and the airy, web-like glass roof has a span of 374 feet. The building is of iron, and the designers have evidently labored to combine beauty and artistic effect with the necessary strength. The girders of the roof spring from the ground, where their lower ends rest on cast-iron sockets imbedded in masses of masonry resembling the piers of a bridge. There are two-story side galleries that provide pleasant promenades, besides furnishing room for light exhibits. In the center are two overhead traveling bridges, which are propelled the whole length of the building by electricity, and afford the visitor excellent means for getting a distant view of the exhibits.

To most men interested in engineering, the machinery hall and the Eiffel tower were the greatest attractions. Like other great works of art or of nature, these structures must be seen to be appreciated. A picture or a model fails to do them justice. The eye cannot magnify a picture or a model to make it give the impression conveyed by the original. The Eiffel tower is 300 metres high—close on 1,000 feet, nearly twice the height of the Washington monument. It is no vulgar spire, where a great mass of material is merely pushed upwards into space much farther than anything ever built before. It is a great work of art and engineering skill, where steel plates have been built up in the most graceful and attractive form. Wherever a sightseer stands watching the tower its form is beautiful and impressive. Writers in all the American publications that have come to my notice have striven to do this great work justice, but I have been surprised to find little but abuse of it in British journals. John Bullism is so rampant among the reptiles that express British opinion in the newspapers that they cannot do justice to anything produced out of their own narrow isle. The common line of disparagement is to compare the magnitude unfavorably with that of the Forth bridge. Every one acquainted with engineering achievements readily admits that the Forth bridge is second to nothing of its kind for magnitude, but it seems a far-fetched comparison to make its greatness a shadow for the beautiful Eiffel tower. The Forth bridge is a noble work, but, as the Scotch say, "It is far frae bein' bonny."

The Eiffel tower and the machinery hall ought to be object lessons to the engineering world on beauty of design. There are so many iron structures formed as if ugliness was a merit and necessity where that kind of material was employed, that it must be a benefit to the world to have such striking examples of beauty of form as are presented in the prominent buildings of the Paris Exhibition, for they prove that the material is not at fault.

The Paris Exhibition attracted a very great number of visitors from abroad, and its financial success is reported to be due to this. An analysis of the attendance sheets, however, shows that foreign visitors constitute but a small proportion of the attendance. The show has been popular in France, and the French people of all ranks have gone to see it. Every day that I was there the country peasants and the city workmen with their wives and families constituted a majority of the multitude within the grounds. The location of the place contributed largely to its success. It was in the very heart of the city, and could be readily reached by all kinds of conveyances.

In the various departments foreign exhibits took an important place, but by far the most important displays were French. To me this was particularly conspicuous in the extensive displays of material employed in railroad engineering.

All departments of railway machinery were particularly well represented in the exhibition. In rolling stock, France and Belgium displays were much ahead of other countries. The workmanship seen on locomotives and carriages was excellent, but there was little in the designs that our railroad companies or builders would be likely to imitate with advantage, so it would hardly be edifying to our readers to enter much into constructive details. Simplicity of design is not a strong point with French railway machinery. Nor is the production of graceful forms. Some of the locomotives have motion that is ridiculously complicated and the shapes of domes, sand boxes, cabs, smoke stacks, and other prominent parts are generally ingeniously ugly. The French railway machinery generally looks as if it were designed by amateurs with prejudices against all pleasing forms and then put into the hands of constructive workmen who were highly skilled in fine finishing. I never saw anything to excel the finish on the working parts—the machinist work—but some of the other work was inferior. Some of the engines had jackets of polished sheet brass, which evidently were fitted by carpenters. Some of the boiler work appeared as if it had been finished by blacksmiths. There is a curious practice among French engineers of placing the steam pipes outside the boilers, and in some cases where double domes are used outside pipes connect them. These pipes are generally well lagged and are made as homely as Gallic ingenuity can devise. The most common type of French locomotive has outside cylinders with steam chests inside, two pairs of coupled driving wheels behind and a single pair of leading wheels. The valve motion is all outside and is hung from the crank pins. The Crampton type of locomotive, with one pair of driving wheels located behind the fire box, is also very common, and has led to the prevailing practice of placing the valve gear outside the driving wheels.

There were several compound locomotives of French make exhibited. Although the French were the first to make the compound locomotive operate successfully, the specimens to be seen there from French workshops are not likely to be much imitated. There is too decided a tendency among the designers to make the machinery complicated. The railway that traversed the grounds was operated by small compound locomotives designed by M. Mallet, who first made the compound locomotive a success; but they are very complicated little traps of engines. A large Woolf locomotive in the exhibition attracted considerable attention, and appeared to be regarded as a particularly fine machine. The cylinders are tandem, the low-pressure cylinder being in front, with the piston connecting to the cross-heads by two rods. The steam chest is above the cylinder, and the valve gearing is all outside the wheels. The engine is very large, carried on four coupled wheels without any truck. The impression conveyed to an onlooker is that the front end is tremendously overhung. Imagine a consolidation locomotive, without the truck, with a very large extra cylinder stuck in front of the common one, with a steam chest to match, and you see the Woolf compound exhibited as a model of good design.

A notable feature about all the French freight locomotives shown was their great size. In this respect they approach American practice. Most European freight locomotives would be called small in America.

Belgian makers displayed a great variety of locomotives. They were decidedly better designed than the French engines, and the workmanship was quite as good, and certain details were better finished. The most notable feature about Belgian locomotives is their large fire boxes, most of them being of the Belpaire form, but in some instances spread out very wide. This was all the more conspicuous as all the locomotives from other countries had what we would consider very small fire boxes in relation to the capacity of boiler and cylinders. The Walschaert valve motion appears to be in favor with Belgian locomotive engineers, and it is generally placed outside the wheels.

For plain, sensible looking machines, the British locomotives exhibited took the lead. The display was small but it reflected the very highest credit upon the designers, the builders and the country. Most of the engines were inside connected, beautifuly proportioned and finished like machine tools. Nearly all the locomotives exhibited were conspicuous for elaboration of finish, but such a thing is to be expected of machinery specially got out for showing highly developed skill and elaborate workmanship. The bogie on which the front end of most British locomotives is carried is getting nearer and nearer to the American patterns, a fact which was impressed upon me at various railway shops in Britain. Mr. Aspinall, of the Lancashire & Yorkshire Railway, frankly said that he was using the plain American bogie. The tendency for some years was to make very heavy trucks of riveted steel plates.

The smoke stacks of most locomotives to be seen at the exhibition, and in fact all over Europe, were noticeable for their small diameter at the narrowest point, which is about 10 inches above the smoke box. Above that it widens out rather more than the form made familiar to Americans by being the standard of the Richmond & Danville, the Erie and other roads. There are, however, a few curious exceptions from this common form of smoke stack. The Northern of France and some Belgium makers exhibited engines that had smoke stacks of rectangular section, very short and very large at the base. They are about as unsightly as the old wood-burning stack, but they are said to answer the purpose of their design satisfactorily. The engines with this form of stack all have unusually large fire-grate area.

One of the most handsome locomotives to be seen in the exhibition was a ten-wheel passenger engine built at Milan, in Italy. The cylinders are set back on the frames, with the front head about three feet from the smoke box, a plan that follows the Crampton design, and is adopted with several other engines. The front end is carried on an extremely massive four-wheel truck, and the engine has a particularly powerful appearance, with a good deal of the American style of design. The workmanship was excelled by nothing in the exhibition, very great attention having been bestowed upon minute details. Another engine that elicited our admiration was a compound locomotive of what has become known as the Worsdell type, built Switzerland. The cylinders were outside, and the engine was notable for simplicity of design, fine proportions and excellent finish.

American readers of engineering journals were some years ago made familiar with the hobby of a French crank who insisted that the proper way to attain high speed with railway trains was to make all the wheels of all the vehicles very large. He put his idea into practice by having an engine and car built with all the wheels 8 feet diameter. Both were exhibited, and attracted considerable attention. The wheels of the engine are all coupled. The car has a long girder frame on which two-story passenger compartments are swung. Both engine and car are roughly constructed, but the inventor, of course, claims that they are a success, since a speed of 66 miles an hour has been attained with them. Both look as if they had languished a great part of their time on unsheltered sidings.

If the locomotives shown at the Paris exhibition are to be regarded as a fair reflection of locomotive engineering in Europe, the practice of using inside connected engines is on the increase. French, German and Belgian locomotives used to be nearly all outside connected, but the inside connected engines are becoming quite common. They are nearly all put together in such a way that the machinery is easily reached, British engines being particularly well arranged in this respect. Two merits are claimed for the inside connected locomotive. It rides particularly steady and affords a good opportunity for fastening the cylinders solidly. Outside connected locomotives all have the cylinders fastened to the frames, and they are much more

given to working loose than the inside cylinders that are cast together or bolted securely into one piece. The indifferently secured outside cylinders cause side oscillation of the engine when working with high piston speed, and this transmits severe strains that lead to breakage and high cost for repairs. Why European builders of locomotives do not bolt outside cylinders together is one of the mysteries that no American engineer can fathom.

Copper fire boxes and brass tubes are almost universally used, and there is no prospect of steel and iron taking the place of the more expensive material. I have talked to a great many locomotive superintendents about the economy of using steel, but with one accord they declare that steel will not stand. Even those who have water as pure as that found in New England insist that steel fire boxes would not last five years. They say that steel cracks so badly that the fire box is not safe.

It is not many years since the usual method of applying sand in Europe to prevent locomotives from slipping was for the fireman to sit on the sand box and drop the sand into the pipes by hand. Great improvements in this respect have been made lately, and dried sand, with automatic means of applying it, is universal. The sand blast for carrying the sand through the pipes and depositing it under the wheel is becoming very common. Where this method is employed very much less sand is necessary to keep the wheels from slipping than where the sand is dropped by gravity, as the particles of grit are deposited right under the wheel. I rode on one of the high speed engines belonging to the Caledonian, that was employed in the first racing of trains between London and Glasgow, and although the train was heavy and the rails particularly slippery and the engine had only one pair of drivers, she got along by using very little sand. The thick coating of sand generally put on in our practice increases the wheel resistance so greatly that time is often lost by it. The Chicago, Burlington & Quincy people have been experimenting with the sand blast, and it would be well for others to find out the extent of its utility.

A notable thing about nearly all European locomotives is their fine wheels. They are all wrought iron or cast steel, and are generally beautifully made. A French engineering firm had in the exhibition a pyramid of wrought iron wheels that displayed wonderful triumphs of blacksmith skill. Some of the driving wheels were eight feet in diameter with the counterbalance weight wrought in and finely distributed. The wheels looked as smooth and clean as American buggy wheels. Wrought iron wheels for locomotives are, however, going out of use. They are very difficult to forge well, and therefore expensive, so they are giving place to centers made of mild steel. Krupp's people appear to be making the greater part of the driving wheel centers used at present not only on the Continent but in England also. Other steel makers do not get out the casings sufficiently free from blow holes to make them acceptable for parts subject to severe service.

In the methods of feeding the boilers, and with lubricators, we are decidedly ahead of European practice. There are few pumps used in Europe, although there are a few notable exceptions as on the London, Chatham & Dover, where pumps are used exclusively ; but inventors on the other side do not appear to have been encouraged to develop the injector, as they have been with us, and consequently crude instruments are, to a great extent, used that cannot be finely regulated. Valves and cylinders are generally oiled by open cups, and the use of lubricators that give a continuous supply is very limited.

The display of railway carriages at the exhibition no doubt represented the finest work and the most advanced practice in Europe; but the finest vehicle shown compared very unfavorably in design and workmanship with such cars as I have lately seen turned out from the Wagner shops at Buffalo. The common railway carriage of the Continent is still the compartment carriage carried on six wheels with no lavatory or sleeping accommodation. But they appear to be inclining toward a change which will give more accommodation and greater comfort to passengers. Carriages carried on wheels secured to the frame seldom ride easily, and when the axle boxes get worn they give so much lateral motion that riding is very uncomfortable, and the jerky movement prevents one from reading with ease. It is becoming recognized that the compartment system facilitates the committing of murders and outrages, and that there is no effectual means of preventing such occurrences where the trainmen have no access to the carriages while the train is in motion. As a means of overcoming these draw-backs designers are getting out carriages that provide means for an attendant overlooking each compartment when the train is in motion. They cannot consent to adopt the simple means provided with the American car with the aisle running through the middle, so they put the aisle outside or at the end of the compartments, as in the Mann boudoir cars. At the Exhibition there were a good many long cars shown carried on trucks, with various arrangements inside for intercommunication. Lavatories and water closets are also provided in many of the cars, including day cars, but there are some curious contrivances resorted to to provide necessary accommodation and yet economize room. The under framing of nearly all the carriages exhibited by Continental makers was made of channel iron, or steel beams with truss rods beneath. The framing of the trucks was also invariably made of channel bars. The London & Northwestern Railway Company exhibited a very handsomely finished sleeping carriage, which is a development of the ordinary English carriage, but it is 42 feet long. It is divided up into small compartments, some of them having two beds and others four. The upper berths are raised and lowered by a parallel motion formed of strong lazy tongs.

In several of the sleeping cars there were rather ingenious means used for getting the upper sleeping berth put out of the way in the daytime. A stove like a small Baker heater is extensively employed for heating sleeping cars and for providing the porter with the means of heating water to make coffee. A train of cars exhibited by the Compagnie Internationale des Wagons—lits et des Grande Express Europien—is vestibuled, and consisted of sleeping, dining, combination and day cars. They are all carried on bogies and have rather an American look excepting the color, which is a dirty green. European designers of railway carriages might get a great many ideas that would be useful to them if they would visit America in a spirit that was open to conviction. European makers generally use excellent wheels to carry their carriages on. They are also a little ahead of us on brake rigging. The brake gear generally looks as if it were designed to stand the pull transmitted from a Westinghouse air cylinder, which ours seldom is.

The European freight cars have no features whatever that would commend them to Americans, except that some of them have good channel iron frames. Very few of them have a carrying capacity of ten tons. There was a curious flat-car exhibited by the Northern Railway of France. It is entirely of iron or steel, and the trucks, which are of heavy sheet-iron, extend out and form the bumpers and means of coupling. The car is about 55 feet long, and is evidently intended for carrying heavy machinery. The wheel base of the trucks is about 11 feet.

The Paris exhibition was a very valuable advertising medium for manufacturers doing a foreign business. Americans, as a rule, are particularly smart in using means of advertising advantageously, and it was surprising, under these circumstances, that builders of rolling stock for foreign countries did not send engines and cars to the exhibition. The only American-built locomotive shown was a small Porter engine that evidently was not finished for display. As most of the machinery exhibited had elaborate extra finish put on, this engine did not give a good impression of the locomotives built in America. It was a great pity that some of our large substantial engines were not exhibited, for European people have got a very erroneous impression of what American locomotives are. The last time that American locomotives were exhibited in Europe was during our nickel-plate period of construction when ornamentation was resorted to to cover defects of design and workmanship. That has left an erroneous impression.

The American exhibit was small, but what there was of it was very creditable, and some things attracted very great attention. Beyond all others in our line was the exhibit of J. A. Fay & Co., Cincinnati. They had a space in the machinery hall 50 × 80 feet, in which were shown 33 different machines for car and bridge work, government navy yards and arsenals, joinery, cabinet making, etc. There was a large planing and matching machine for dressing the four sides of boards or flooring and beading the edges, which has many novel features and was much admired. There were vertical and horizontal automatic sawing machines for cutting up boards and timbers that worked with wonderful rapidity. Wood-workers of several varieties, with molding and boring attachments for every class of work, also band-sawing machines for both scroll work and resawing planks and deals into thin boards. Planing machines of quite original design and excellent workmanship for reducing thick timber. Tenoning machines that will cut single, double or triple tenons on the end of material from an inch to 14 inches square. Ripping saws for cutting to width material with one and two saws, and which can be changed at will to throw the saw blade on any angle. There was a very interesting new mortising machine, with a hollow chisel that bores a square hole of any size, and makes a mortise in one minute that a workman could not make in one hour. The work done by this machine was an object of great interest to all sorts of visitors, and thousands were proud to carry away a piece of wood bored with a square hole. In fact, specimens of all the principal machines made by this firm were exhibited, and there was nothing in the exhibition to compare with them in ingenuity of design, simplicity of action or beauty of finish. The machines were driven by an engine on their own space to lines of shafting below the floor, so that there were no belts in sight, a very unique and excellent installation well worthy of general adoption. In the center of their exhibit was a fine office finished in mahogany, with handsome pavilion, canopied with silk, and surrounded with samples of the work their machines produce. Entering the door which was draped with American and French flags, we found the office luxuriously furnished with all required to make a tired visitor comfortable, and moreover experienced a cordial welcome from Mr. W. H. Doane, president of the company, who has all the time been in charge of the exhibit and personally superintended the installation. Mr. Doane's office appears to have been the headquarters of Americans attending the exhibition, and many speak very cordially of the kindness received from that genial gentleman. The company received the "Grand Prix" for wood-working machinery, and it appears to have been thoroughly deserved.

William Sellers & Co., Philadelphia, had a very creditable exhibit. Among them I noticed two fine planers, one of them 36 × 8, which took the grand prize. The return speed of this planer was 8 to 1, and it excited a great deal of attention among machinists from all parts of Europe, as well it might, for fast return is not a noticeable peculiarity among planers in Europe. There was an impression that this planer would break down when it began to work, and many appeared to be disappointed that it did not fail. There was also one of the famous tool grinders made by this firm on exhibition, besides a vertical drill press, a twist drill grinder, some injectors, and other products of the works, all of them comparing well with the fine tools displayed by European mechanics.

Brown & Sharpe, Providence, exhibited twenty machines of various kind, and they very deservedly got the grand prize for their milling machine. It was highly proper that this firm should make a good showing at the exhibition, for they must already have a good business in supplying their special tools to foreign machinists. In our peregrinations through European workshops we saw more Brown & Sharpe tools than those of all other American makers combined. Their universal milling machine appears to be particularly well known and highly valued.

Besides those mentioned, there was a great variety of minor exhibits by American manufacturers. Post & Co., Cincinnati, had an exhibit of headlights ; the Peckham Car Wheel Company, New York, had some wheels and axles. Their paper wheel attracted considerable attention. The Ingersoll Rock Drill Company, New York, had a good exhibit, perhaps as good as anything in their line displayed.

American electrical companies made a highly creditable display. Nothing in the exhibition attracted greater attention than the electrical welding operations performed by the Thomson-Houston Company, of Boston. They had four apparatus for welding, and they were kept a great deal at work, to the delight of multitudes that eagerly watched the work. The different forms of electric lighting provided by the company were also displayed in highly attractive forms, besides many other interesting electrical apparatus.

No American product appeared to get so much commendation at the exhibition as "Valvoline." In all tongues and by all sorts of signs visitors were informed that "this machine is lubricated by 'Valvoline.'" Several engineers whom we questioned about the lubricant spoke enthusiastically about it.

The Iron Car Company, New York, exhibited the lower frame work and truck of one of their cars and these parts attracted the attention of a great many railroad men. The Merchants' Despatch Company exhibited a finished car which also was the object of much attention and was generally regarded as a common American freight car.

The car coupler man of course was present. Dr. Laird's automatic car coupler was a particularly crude link and pin concern, made with a jack knife, evidently, and applied to miniature cars fashioned with the same type of tool. But the exhibitor talked with full assurance that his was the coming coupler.

In the exhibits of sewing machines and typewriters American manufacturers were second to nothing at Paris. Agricultural implements were also well represented. The exhibition turned out to be a much greater affair than most Americans realized it would be. Had they understood properly the magnitude of the attractions to be presented and the many countries that would be represented by visitors, it is likely that our manufacturers would have been more generally exhibitors. As it was America had nothing to be ashamed of.

The Grant Locomotive Works have taken a contract for five Leslies rotary steam snow shovels. There is considerable work on these snow shovels, and it is expected that in a few weeks the Grant Works will have a very busy appearance, and may remain so up to January.

Work has been resumed on the Mont Clare shops of the Baltimore & Ohio Road, near Baltimore, and several hundred workmen who were laid off have been re-employed. Four additional vestibule trains will be equipped for service between Baltimore and Chicago. Eleven new coke burning engines have recently been placed on the New York and Washington branches.

Extensive machine shops, said to be the largest west of the Mississippi, have been built by the Mexican National Railway Company, at Laredo, Tex. The buildings are of brick, with 18-inch walls, and iron truss roofs covered with corrugated iron. Round house, 65 × 100 feet, 18 feet high, 20 stalls; foundry, 60 × 75 feet; erecting shop, 60 × 119 feet; blacksmith shop, 59 × 60 feet; two engine houses, 59 × 60 and 30 × 31 feet; wood working shop, 60 × 250 feet; machine shop, 60 × 180 feet; paint shop, two stories, 70 × 105, and 60 × 70 feet: engine house, 30 × 35 feet; boiler house, 40 × 40 feet. Also brick buildings for store rooms, offices, etc., and a bonded warehouse 30 × 250 feet, with a 20-inch wall and a tin roof.

Compound Locomotives.*

BY PROF. ARTHUR T. WOODS.

Fourth Paper.

THE MALLET SYSTEM.—The Mallet system of two-cylinder compound locomotives has been already referred to as that in which by means of suitable valves the engine may be operated as a simple engine not only in starting, but at any time when in service. Such an engine, while having all the advantages of compound working, possesses an emergency power equal, or possibly superior, to a simple engine having the same general dimensions.

Figs. 17 to 20, inclusive, illustrate the arrangement of this system as applied to a converted six-coupled engine of the Western Switzerland Railroad. For the drawings from which the illustrations were made, and also for other data, I am indebted to Mr. Mallet. The cylinders are 17.7 and 25.6 inches in diameter by 25.6 inches stroke, one of the old cylinders having been retained as the h. p. cylinder. The driving wheels are 58.4 inches in diameter, and the working weight, which is all on the driving wheels, is 79,350 pounds.

In Fig. 17, *h* and *l* are the h. p. and l. p. cylinders, respectively, *A* is the main steam pipe from the boiler to the h. p. cylinder, *B* is the receiver, *C* is the l. p. exhaust pipe, *D* is the starting valve which is connected to the boiler by the pipe *E*, *F* is the intercepting valve, and *G* is the exhaust pipe from the h. p. cylinder when working as a simple engine.

The construction of the starting valve is shown in Figs. 18 and 19. It consists primairily of a short slide valve *a*, which, as shown, covers two ports leading to the receiver. The pipe *p* connects the starting valve chamber with the main steam pipe. On the back of the valve *a* is an inverted slide valve *b*, which slides on a seat formed in the valve-chest cover. A small pipe *c*, connects the starting valve

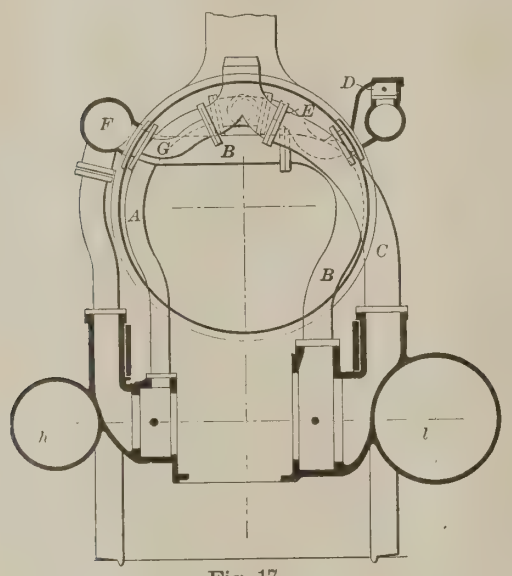


Fig. 17

chamber with the intercepting valve, on the other side of the smoke box, as show at *c*. Fig. 20. Referring now to Fig. 20, it will be seen that the intercepting valve consists of two circular valves and a piston, all being mounted on one stem, and so forming a sort of balanced double poppet valve. The connections to the intercepting valve are as indicated in the figure, the central opening connecting with the h. p. exhaust, the left with the common exhaust nozzle and the right with the receiver pipe.

The operation of these valves is as follows: They are shown in the illustrations in the positions which they ordinarily occupy, or when the engine is working as a compound. Under these circumstances steam from the boiler is admitted to the space *d* back of the piston *e* by way of the small pipe *c*, the starting valve chamber, and the pipe *p*. The pressure thus acting upon the piston *e* keeps the valve *g* closed against the ordinary receiver pressure. The intercepting valve can, of course, be connected so as to be worked by hand in connection with the starting valve. If now the starting valve is opened, or moved to the right in Fig. 18, steam from the boiler is thereby admitted to the receiver, and at the same time the pipe *c* is placed in communication with the atmosphere by means of the cavity in the top of the starting valve. The pressure back of the piston *e* being thus reduced, the valve *g* is opened by the receiver pressure, and the valve *h* is closed, in which position it is retained by the excess of the pressure in the receiver *k*, Fig. 20, or that on the l. p. side of the valve, over that on the h. p. side, which is now in communication with the exhaust nozzle. It will be seen that the locomotive will now work as a simple engine, and will continue to do so as long as the starting valve is kept open. As soon as it is closed, the intercepting valve will be returned to the position shown in Fig. 20.

On the engine illustrated by Fig. 17, a pressure-reducing valve is inserted between the starting valve and the receiver. This reducing valve is of the common differential piston type, adjusted by springs. In addition to this the receiver is fitted with a spring safety valve loaded to 70 pounds pressure. It would seem when a starting valve of this form is used in conjunction with a safety valve, that

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the introduction of a reducing valve is unnecessary, as the receiver pressure can be regulated by the starting valve.

In earlier designs Mr. Mallet has combined the starting and intercepting valve in one distributing valve. This is illustrated by Figs. 21 and 22, which are reproduced from *Engineering*. The distributing valve and a reducing valve are enclosed in a casing which is fastened to the smoke box. The main steam pipe is connected at *a*, and thence by a passage *b*, back of the valves, to the h. p. steam chest. An opening at *c* admits steam from this pipe to the reducing valve chamber and thence to the distributing valve chamber. The distributing valve is a slide valve, and covers three ports, as shown. Of these *d* is the h. p. exhaust, *e* connects with the receiver, and hence with the l. p. steam chest, and *g* leads to the exhaust nozzle. The

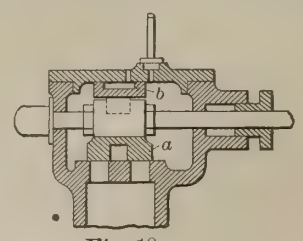


Fig. 18

valve is shown in the position for compound working. If it is moved forward, or to the left in the illustrations, the passage *d* is connected with *g*, and the h. p. cylinder exhausts directly to the exhaust nozzle, and at the same time by means of the passages *c* and *e* boiler steam at reduced pressure is admitted to the receiver and the l. p. steam chest.

In the earlier Mallet engines the lifting shaft is divided so that the valve motion of each cylinder is to a certain extent independent of the other. The h. p. valve gear is controlled by a screw and nut, which takes the place of the ordinary quadrant. The nut which is on the h. p. reverse lever carries a short sector or quadrant and a latch on the l. p. reverse lever works in this sector. The effect is that both cylinders can be reversed by moving the h. p. lever; while by adjusting the l. p. lever, the cut-off in that cylinder may be made either later or earlier than that in the h. p. cylinder. It is obvious that the same principle can be applied to the type of reversing gear common in this country by connecting the h. p. valve gear as at present, and connecting the l. p. reverse lever to the h. p. lever by means of an auxiliary quadrant carried by the latter. A device for tripping the latch of the l. p. lever might be advisable, so that the h. p. lever could be moved between the two extremes in both directions without regard to the position of the l. p. lever. It is, however, by no means proven that it is necessary or advisable to have two reverse levers, and, in fact, the weight of evidence appears to be to the contrary.

For the locomotive illustrated in Fig. 17, Mr. Mallet has adopted a differential motion for the purpose of obtaining a later cut-off in the l. p. cylinder in both forward and backward gear. The principle of this motion is illustrated by Fig. 23. In this Fig., *A* is the lifting shaft and *B* is an auxiliary shaft. The lifting arm *M* of the h. p. link and the arm *C* are keyed to the lifting shaft, while the l. p. lifting arm *N* and the arm *H* are in one piece, which turns about this shaft. The slotted arm *D* and the arm *E* are

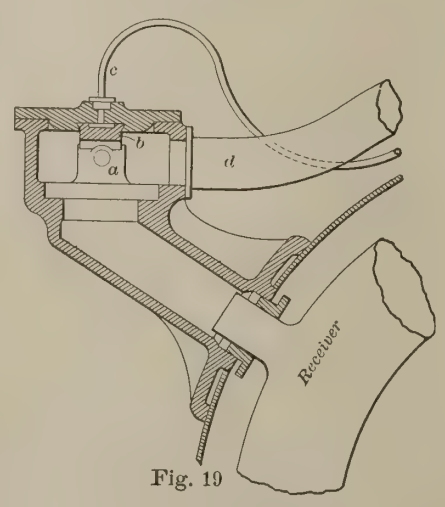


Fig. 19

keyed to the auxiliary shaft. The arm *C* carries a block which slides in the slotted piece *D*. The parts are shown in the Fig. in a position for backing, the l. p. link being raised higher than the h. p. link and therefore cutting off later. In full backing gear the arms *M* and *N* would be parallel and hence give the same cut-off in both cylinders. In mid-gear the arms *C* and *D* are on the center line *A B*, while in forward gear, or to the left in the Fig., the lifting arm *N* is lowered more rapidly than the arm *M*.

Mr. Mallet gives the following as the distribution obtained with this arrangement:

	Forward Gear.						Backward Gear.		
High-pressure cylinder...	.70	.60	.50	.40	.30	.0	.0	.60	.70
Low-pressure cylinder...	.70	.65	.60	.55	.50	.0	.0	.65	.70

STEAM PASSAGES.—It would seem to be an unquestionable principle of steam engine design, that all steam passages should be large and as free from abrupt bends and contractions as it is possible to make them, and should be so placed and protected that the loss by radiation will be reduced to a minimum. With these principles in view, there appears to be room for improvement in the designs of many existing compound locomotives in one or more particulars.

The proportional areas of steam ports in the two-cylinder compound locomotives which have been examined are somewhat less than in recent American locomotives. Mr. von Borries recommends areas which, for a cylinder ratio of two, would be about 8 to 8.2 per cent. of the piston area for the high-pressure, and 7 per cent. for the low-pressure cylinder for passenger engines. For freight engines having slower piston speeds, the areas may be 10 per cent. less. Mr. Worsdell's practice for both passenger and freight engines appears to be 8.1 per cent. for the high-pressure cylinder, and about 6.4 per cent. for the low-pressure. These proportions give for cylinders 18 and 26 inches diameter by 24 inches stroke; high-pressure steam ports, 1¼ by 11⅝ inches; low-pressure steam ports, 2 by 17 inches; exhaust ports, 3½ inches wide and of the same length as the steam ports.

The volume of the receiver should not be less than that of the h. p. cylinder, and preferably should be larger than this, in order that the fluctuation in the h. p. back pressure may be as small as possible. Also in engines of the Worsdell and von Borries type a large receiver will permit a more satisfactory action in starting than a small one, as more time will be required to compress the exhaust steam from the high-pressure cylinder to the pressure necessary to open the intercepting valve. For engines of "ordinary size" Mr. von Borries gives 200 mm. (7⅞ inches) as a suitable diameter for the receiver pipe, with a thickness of about ¼ inch when made of copper.

SLIDE VALVES.—The most noticeable difference between the distributing valves of compound and ordinary locomotives is in the large inside clearance of the former. This is made necessary by the high pressure of the back pressure line of the h. p. cylinder, and the consequent necessity of securing a late exhaust closure in order to avoid excessive compression in that cylinder. For the l. p. cylinder there are similar requirements, as, with the same back pressure as in simple locomotives, the pressure at the end of compression should not exceed that in the receiver. The necessary

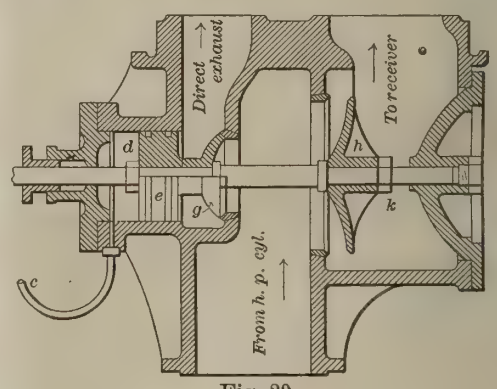


Fig. 20

changes from the ordinary valves may perhaps be best illustrated by giving a few examples of the proportions which have been adopted:

	Width of port.	Travel.	Outside lap.	Inside clearance.	Lead.
H. P.	1¾	5¼	1⅝	¼	3/16
L. P.	2	5¼	1 5/16	⅛	3/16
H. P.	1¾	5¼	1⅝	¼	3/16
L. P.	2	5¼	1⅝	⅛	3/16
H. P.	1.6	3*	1.4	.3	.1
L. P.	2	3	1.4	0.0	.1
H. P.	1.35	2.65	1.3	.26	.1
L. P.	1.44	2.58	1.15	0.0	.06
H. P.	1	4.2	1.12	.25	.02
L. P.	1.16	4.5	1.12	0.0	— .03

* Mid-gear travel. These dimensions are advised by Mr. von Borries.

These dimensions are given simply as illustrations, as of course the proper dimensions for any engine can only be determined satisfactorily by the use of a model, or by drawing the motion to full size. In either case adjustments by the indicator should follow, as the economy of the engine will depend very largely upon the care and attention given to the steam distribution.

SIZE OF CYLINDERS—TRACTIVE POWER.—A comparison of existing compound locomotives and of the rules suggested by different writers, shows about as much difference of opinion as to the proper proportions of cylinders, boiler pressure, driving wheel diameter and adhesion weight, as was found in ordinary locomotives by the committee of the Master Mechanics' Association on the subject in 1887.

The following is translated from the fourth edition (1888) of Mr. von Borries' pamphlet on Compound Locomotives: "To compute the size of the cylinders, we suppose, for the sake of simplicity, that the whole work is to be done in the large cylinder, the diameter of which is then computed by the following formula: $d^2 = \frac{2ZD}{ph}$. In which d = the diameter of the l. p. cylinder; Z = the required tractive force = 0.15 of the adhesion weight (where allowance is made in Z for the external engine friction, taken as equal to that for cars); D = the diameter of the driving wheels; p = mean effective pressure (after deducting internal machine friction); h = stroke of piston. The value of p de-

pends upon the relative volumes of the two cylinders, and from experiments and indicator cards may be taken from the following table :

	Ratios of cylinders.	p for 176 lbs. boiler pressure.
Large locomotives with tenders.	1:2 to 1:2.05	74 lbs. (42 per cent.)
Tank locomotives.....	1:2.15 to 1:2.2	71 lbs. (40 per cent.)

For locomotives for roads having many and long grades a larger co-efficient of adhesion ($Z = 0.16$) is to be used, to obtain larger cylinders ; but 0.15 is ordinarily sufficient."

" For compound passenger and express locomotives, the diameter of the large cylinder may be made 1.5 that of the cylinders of the ordinary locomotive for the same service, the steam pressure being at the same time increased 15 to 30 pounds. This is based upon the supposition that the ordinary locomotive is properly proportioned. The working conditions should also be kept in view, so that the locomotives may work as much as possible at the

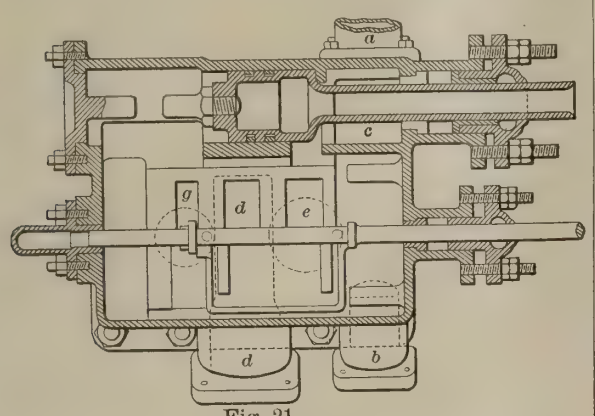


Fig. 21

more economical points of cut-off of 0.3 to 0.4 in the small cylinder."

For a passenger engine of 57,300 pounds on the driving wheels, Mr. von Borries gives the cylinder dimensions as 16.5 and 23.6 inches in diameter by 22.8 inches stroke, and says that such an engine will accomplish 10 to 15 per cent. more than a common locomotive having about the same heating surface.

The following statement is made in the paper by Mr. Lapage, from which I have already quoted : " It is customary, when not otherwise specified, to make the size of the high-pressure cylinder the same as that of the cylinder of an ordinary locomotive. Such engines are found to haul from 5 to 10 per cent. heavier trains, while saving about 10 per cent. of fuel."

In a paper on " The Compound Principle as Applied to Locomotives," read by Mr. Edgar Worthington in January, 1889, before the Institution of Civil Engineers, we find it stated that the high-pressure cylinder should be made about one inch larger in diameter than the cylinders of an ordinary engine of equal power, even though an advance of 30 pounds per square inch of boiler pressure was contemplated for the compound engine.

The difference of opinion among designers may perhaps be best illustrated by a short table.

Weight on driving wheels. Pounds.	Diam. of driving wheels. Inches.	Boiler Press're. Pounds.	Stroke. Inches.	Actual diam. of cylinders. Inches.		Diameter by	
				h. p.	l. p.	Von Borries' Formula. l. p.	Mast. Mech. Formula. Simple.
57,320	73.2	176	22.8	17.3	24.8	27.3	17.5
57,300	68.1	176	22.8	16.5	23.6	26.4	16.9
88,250	52.4	174	24.8	18.1	25.6	27.6	17.2
68,000	80.25	170	24.0	18.0	26.0	30.9	19.8
40,320	85.25	175	24 0	18.0	26.0	24.2	15.5
93,700	61.25	160	24.0	18.0	26.0	32.0	20.3
101,600	61.25	160	24.0	18.0	26.0	34.0	21.8
46,480	42.5	160	21.6	10.6	17.0	20.2	13 0
.....	60.00	120	24.0	18.0	24.0	....	*16.0
79,350	58.4	140	25.6	17.7	25.6	30.4	19 5

* Original diameter, simple engine.

In the last column of the table are given the diameters of cylinders for simple locomotives having the same boiler pressure, adhesion weight, and diameter of drivers, calculated by the Master Mechanics' formula. In the column preceding this are given the diameters of the low-pressure cylinders calculated by the von Borries formula, as already quoted. It will be seen that this formula gives, in general, larger results than are found in practice. The same formula, as quoted in the 1886 edition of " Recent Locomotives," contains values for Z and p, which will give diameters about 7 per cent. smaller than with those quoted above, which indicates that Mr. von Borries has concluded that larger cylinders are advisable.

It appears to the writer that no general rule can be devised which would be applicable to all cases, and that the character of the work which is to be required of the compound engine, as shown by a study of the work done by the simple engine which it is intended to replace, is the only safe guide. The maximum and minimum limits of mean pressure between which the engine will probably work, the usual demand upon it as determined by the character of service, and the type of starting device which is to be employed, must all be given consideration. In brief, if full advantage is to be taken of the economical possibilities of the compound locomotive, the first requisite in attempting its design is a thorough understanding of what it is expected to do.

The most satisfactory method of comparing the work done by simple and compound locomotives is a comparison of indicator cards taken from the two forms of engines under the usual working conditions. Complete sets of such cards from compound locomotives have not been obtainable, but a sufficient number of cards are included in the following table to make it of some value.

	Compound.									Simple.		
No.	Rev. per min.	Boiler pressure.	Initial press. h. p.	Cut-off, h. p.	Cut-off, l. p.	Mean press. h. p.	Mean press. l. p.	Mean l. p. press. ref. to h. p.	Average mean eff. pressure. (a)	Mean eff. press. (b)	Cut-off.	Boiler pressure.
1	27	170	160	.73	.86	100.0	53.0	110.0	105.0	121 5	....	....
2 .	42	170	170	.70	.85	106.6	43.0	89.4	98.0	122.0	.71	148
3.....	*37	162	160	.70	.73	92.2	44.9	89.8	91.0	119.0	.75	146
4	*74	173	165	.60	.65	75.6	37.1	74.2	74.9	111.0	....	139
5.	114	170	154	.50	.60	89.4	45.1	91.5	90.5	85.0	....	130
6	*80	162	150	.60	.65	68.3	37.3	74.6	71.4	96.0	.46	146
7.... ...	135	170	138	.50	.60	60.9	35.3	71.7	66.3	101.0	.58	140
8	*128	176	132	.80	.80	65.3	31.7	63.4	64.3	80.0	.46	140
9.....	147	170	160	.50	.73	67.5	29.8	62.0	64.7	62.0	.34	130
10	120	162	157	.50	.50	57.2	33.2	83.0	70 0	60 0	.42	130
11	150	168	143	.30	.40	46.7	29.4	59.7	53.2	59.5	.42	135
12.....	161	176	162	.30	.40	52.0	26.7	54.5	53.2	53.0	.34	130
13.....	161	176	166	.40	.50	62.9	33.6	68 5	65.7	58.5	.33	138
14..	162	177	145	.40	.50	61.4	36.3	73.7	67.5	75.6	.42	128
15.....	171	176	152	.20	.30	47.0	23.9	48.8	47.9	53.8	.29	136
16	180	172	131	.30	.40	48.2	28.9	58.7	53.4	59.0	.38	144
17.....	195	170	141	.40	.50	53.9	27.6	56.0	54.9	53.5	.36	136
18.....	209	160	147	.50	.73	56.5	26.0	54.1	55.3	52.0	.29	148
19	230	175	148	.75	.	55.7	24.8	51 6	53.6	49.2	.36	137
20.....	272	175	173	.65	....	41.1	19.2	39.9	40.5	43.0	.36	135

* Rev. of simple engine; speed of compound not known.

The figures given for the compound engines were selected principally from reports of the performance of various two-cylinder engines which have appeared from time to time in foreign technical journals, and may be assumed to be at least a not unfavorable representation of their capabilities. For the simple engines cards have been selected, which were taken at nearly the same number of revolutions as those of the compounds, in order to eliminate the question of speed as far as possible. For convenience in comparing the mean pressures in the two types of engines, the average of the h. p. mean effective pressure and that in the l. p. cylinder referred to the h. p. cylinder is given in column (a). It is, of course, not to be assumed that the figures given in the same line necessarily represent the best that either engine can do, and isolated examples form no basis for argument, but a comparison of columns (a) and (b), together with the points of cut-off, clearly shows some of the advantages and disadvantages of the compound as compared with the simple system. It is to be borne in mind that the results given in the table for compound locomotives represent compound working in all cases, and not their capacity when working as simple engines by means of starting or distributing valves. The question of starting power will be discussed subsequently.

The table shows that the maximum average mean pressure of the compound is less than that readily attainable in the simple engine at slow speeds and late cut-offs. For example, in line 2 of the table, the points of cut-off being nearly identical, the compound gave an average mean pressure of 98 pounds, with 170 pounds boiler pressure, as against a mean pressure of 122 pounds for the simple engine, with 148 pounds boiler pressure. The compound is evidently deficient here, and it is necessarily so. The total possible range of pressure in the two cylinders is from 170 pounds to the atmospheric pressure. If there were no

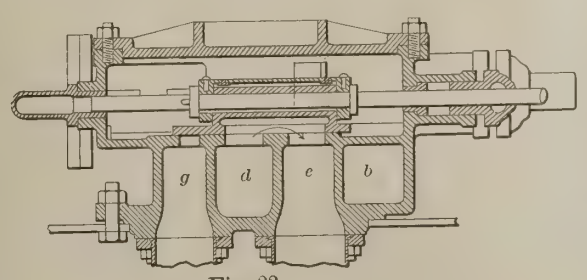


Fig. 22

losses and the full initial pressure could be maintained throughout the h. p. stroke, the maximum mean pressure, assuming two as the cylinder ratio and an equal division of work, would be two-thirds of 170 in the h. p., and one-third in the l. p. cylinder, or about 113.3 and 56.7 pounds respectively. These are the maximum mean pressures attainable with 170 pounds boiler pressure. It follows directly from this that if it is required that the compound shall have tractive power equal to that of the simple engine in this case, the area of the high-pressure piston would have to be greater than that of the simple engine, in the proportion of about 122 to 100, even though the boiler pressure be increased 20 pounds.

On the other hand, a further inspection of columns (a) and (b) shows that at the earlier points of cut-off and higher speeds, the compound engine is about equal to the simple engine, from which it follows that a high-pressure cylinder of the same size as one cylinder of the simple engine would be sufficient. The correct size for the h. p. cylinder is undoubtedly somewhere between these two limits ; for if designed for the power necessary at high speed it will probably be deficient at slow speed and late cut-off ; and on the other hand, if made large enough to meet all emergencies, the engine will be over-cylindered for ordinary running.

If over-cylindered, the effect will be that, when the only work required of the engine is to maintain the speed on level parts of the road, the necessary mean pressure will be obtained with an earlier cut-off than is advisible with the common forms of valve gear, and as a result of the large ratio of total expansion, the final pressure in the l. p. cylinder will be very low, possibly below the atmospheric pressure. The conclusion which seems evident is, that in designing a compound to take the place of a simple locomotive, the basis for calculation should be, as has been already stated, a detailed record of the work done by the simple engine, taking into account the number and rise of grades, the variation in weights of trains, and the frequency of stops.

The table also shows clearly one of the causes of the economy of the compound locomotive. Comparing lines

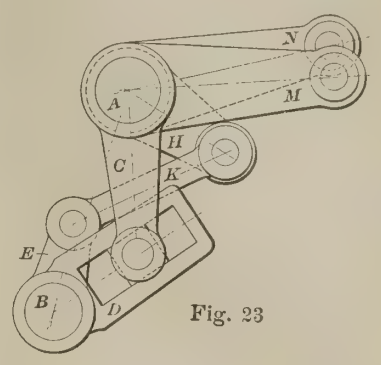


Fig. 23

11 to 17, inclusive, we find that the average mean effective pressure of the compound engines is 56.5 against 58.7 in the simple engines, the average cut-off being .33 in the h. p. cylinder of the compound and .36 in the simple engine. It appears from this that the compound engine will do the same work with about one-half the *volume* of steam. This is not, of course, a measure of the economy, but it is an indication of one of the causes of the economical performance of compound locomotives.

In the NATIONAL CAR AND LOCOMOTIVE BUILDER of September, 1889, were given a number of indicator cards which serve admirably, in connection with data given in the accompanying description, as an illustration of the application of the principles of design just discussed. Particulars are given of twenty-seven cards, for which the speed ranges from 120 to 312 revolutions, and the mean effective pressures from 71.3 to 41.8 pounds, the average mean effective pressure being 49.8 and the mean cut off about .34. The engine was hauling the New York and Chicago Limited, and only one stop was made between New York and Albany. An examination of the above table indicates that a two-cylinder compound locomotive having a high-pressure cylinder of the same size as a cylinder of the simple engine, and with 170 or 175 pounds boiler pressure, could haul this train under ordinary circumstances without difficulty, the only additional requirement which is apparent, being the adoption of some form of starting valve which will insure a starting pressure of about 122 pounds in the h. p. cylinder and its equivalent in the l. p. cylinder. This appears to be a very simple case, the principal remaining question being, how often would the engine be required to develop more power than is shown by these indicator cards ? The records of the road should furnish the answer which will indicate whether it is necessary or not to increase the size of the cylinders, and if so, the amount of such increase.

There appears to be every prospect of the New York Railroad Club being infused with new life. At the annual meeting held on Nov. 21, a new set of officers were elected, and all of them are live, energetic railroad men. Many other railroad men have promised to give the club their active support. The new officers are Ross Kells, president ; R. C. Blackall, first vice-president ; W. L. Hoffecker, second vice-president ; L. R. Pomeroy, secretary ; C. A. Smith, treasurer. The executive committee are H. Tandy, W. C. Ennis, Thos. Aldcorn, W. H. Lewis, J. W. Baker, Thos. Millen, H. S. Hayward and H. A. Webster.

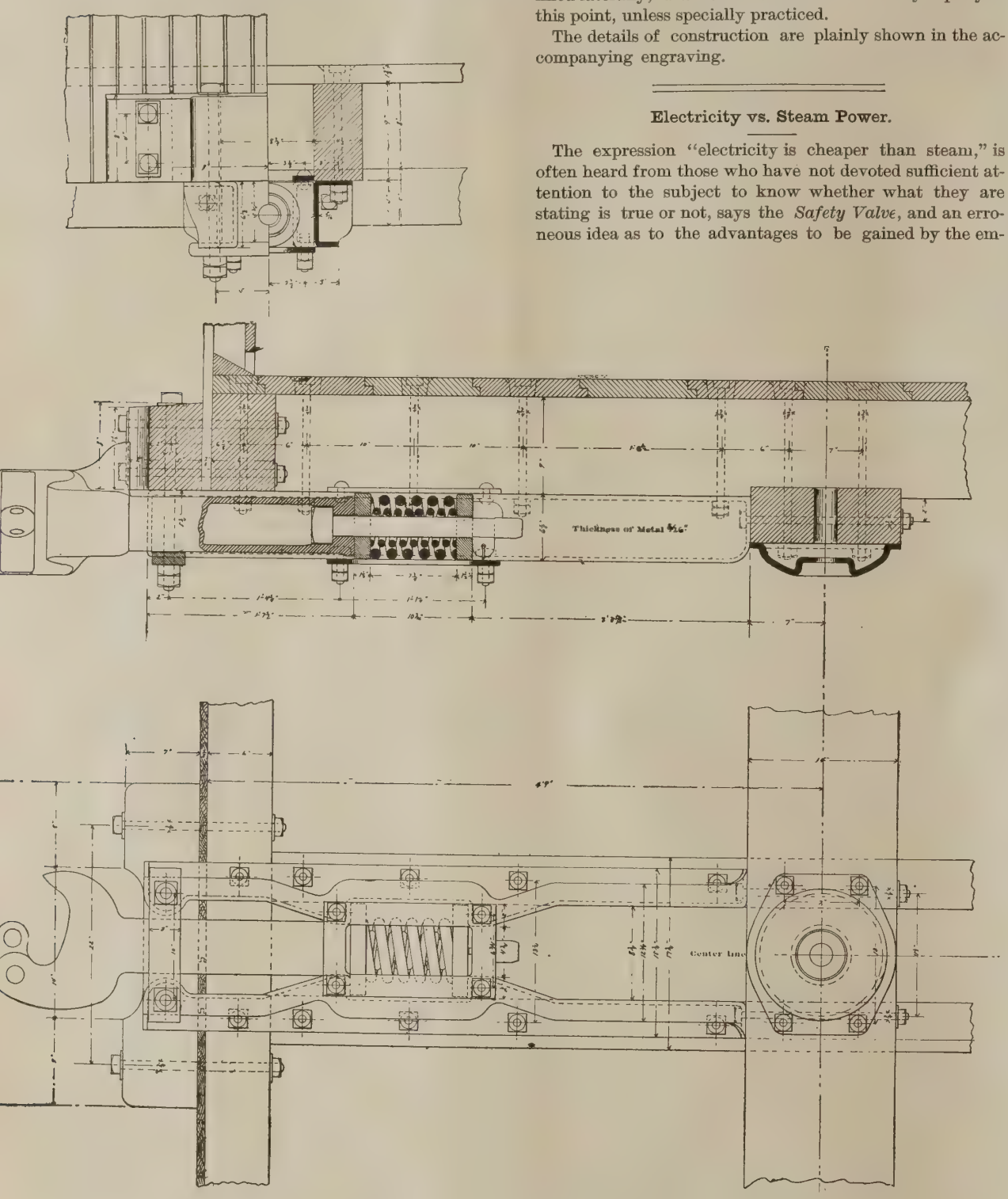
The Chicago, Burlington & Quincy, like other railroad companies operating lines in Iowa, have been losing money in operating branch lines through the small revenues resulting from the low rates made compulsory. As a means of reducing operating expenses, they have been curtailing train service on branches that did not pay. The citizens of Mount Ayr, a small town, complained to the Railroad Commissioners that they were not receiving sufficient train accommodation, and the commissioners have rendered a decision to the effect that more trains should be put on, although the company showed conclusively that the trains would be run at a loss. This outrageous decision is likely to be expensive to other companies, for every sparse district in the State is now likely to claim an increased train service, and the Railroad Commissioners may be depended on to help out the people who have a voice in their election, no matter how unjust the decision may be to railroad companies.

New Draw-bar Attachment.

The above illustrated draw-bar attachment for freight cars has lately been brought out by the Fox Solid-Pressed Steel Company.

Those attending the Alexandria Bay convention in 1888 will remember the exhibition of a steel car truck composed of flanged plates, and which attracted so much attention by reason of its novelty of design and beauty of workmanship. This truck was manufactured by the Leeds Forge Company of England for the state railways of India, in which country iron and steel are almost exclusively used in the construction of cars.

This class of work is produced on large hydraulic presses which were originally constructed for the purpose of flanging boiler heads, Mr. Fox's principal business being the manufacture of corrugated flues for marine and stationary boilers. He succeeded so well that both his flues and heads are now specified for all new ships of the English navy, and are also used in all the large fast Atlantic steamers.



NEW DRAW-BAR ATTACHMENT.

A newly-formed Chicago company purchased Fox's patents for flanging and erected extensive works, which are now completed and in operation at Joliet, Ill., in close proximity to the rolling mills of the Illinois Steel Company, at that place.

This draw-bar attachment, for which a number of orders have already been received, is but one of the many instances where steel plates, treated as they are by this process, can be used to advantage in both locomotive and car construction.

In this design no radical changes that would interfere with established standards are made. Whatever particular draw-bar, tail-bolt or yoke, spring and follower plate may be in vogue can be retained. In fact, there is no change other than substituting for the present wooden draw-bar timber and cast-iron stops a steel beam pressed from one single plate in such a manner that stop castings, their bolts, etc., are dispensed with. It is attached to the under side of the draw sills, for which purpose the existing bolt-holes may be utilized; an additional and direct-acting bolt passes through the flange at the rear of the beam and through the body bolster, which is in this case of wood. The design is slightly altered at this point for cars constructed with iron bolsters, the beam in that case extending beyond the bolster to any desired distance. There is practically no limit to the strength of these beams, as they may be any thickness of plate, and, if it were desirable, can be made the strongest part of the car.

Some of the advantages claimed for this gear are: A great reduction in the number of the parts now making up the whole; less trouble from loose bolts, as a number of them are done away with, and those remaining passing through but 8 inches of wood, against 15 inches in the present method, the shrinkage to which loose bolts are principally due will be correspondingly less; the follower plates; coming in contact with steel only, are better confined laterally; draw timbers of wood wear very rapidly at this point, unless specially practiced.

The details of construction are plainly shown in the accompanying engraving.

Electricity vs. Steam Power.

The expression "electricity is cheaper than steam," is often heard from those who have not devoted sufficient attention to the subject to know whether what they are stating is true or not, says the *Safety Valve*, and an erroneous idea as to the advantages to be gained by the employment of electric power is frequently imparted. Under certain circumstances electricity is cheaper than steam as a power, but invariably in indirect application. Where it comes to the employment of steam power directly, it must naturally be cheaper than electricity, for the simple reason that the cost of converting the motive force developed by steam into electric current and then changing it back again into power, involves a certain amount of loss by friction or otherwise.

A good dynamo is capable of delivering, say, 90 per cent. of the power of the engine operating it in the shape of working force, and it is for the engineer to calculate whether or not this is a saving over ordinary means of transmission. When the weight of shafting, pulleys and belting is taken into consideration, together with the friction they create, it will be very evident that in most cases it will involve a greater waste than 10 per cent. of the power developed. Nor is this the only point to be considered. The transmission of power by shafting or gearing necessarily involves risk of a breakdown, which may be serious enough to put an entire stop to operations. Where the power is distributed to a large number of small machines, and they are, as is frequently the case, placed at irregular, but convenient points, the difficulty of connecting them all, the loss of friction and the liability to break down are all increased.

How much easier, under these circumstances, it is to manage a power plant operated by electricity, no matter how complex the arrangements. The wire being flexible can be run without trouble in any direction to the motor, placed wherever power is desired. A separate motor can be attached, if preferred, to each machine in use in large establishments, and, by means of a well-arranged switch-board and primary power, properly subdivided, it is possible to run any part or the whole of a factory, according to the work to be done. The wire is subject to no wear; it occupies no space to speak of; it never requires lubrication, and consequently causes no oil or dirt.

If, however, electricity is desirable for use as a substitute for steam power, where the employment of the latter is admissible, how much more advantageous it is where other forms of power are open to serious objections. In the operation of a ventilator, for instance, in a room for running light household machinery, the small tools used by dentists and watchmakers, etc., the convenience, cheapness and noiselessness of the motor makes it a prime favorite; and it is really much cheaper for such purposes, the subdivision of steam power to such an extent being unavoidably attended with an extra percentage of loss of friction.

It is, according to the opinion of many practical electricians, only a matter of time before the electric motor will be adopted for nearly every purpose for which steam power is now used, reducing the independent steam plants to the smallest possible numbers in the interest alike of safety and economy, for it has been abundantly demonstrated that in proportion to the power it furnishes, and with the best type of boiler and engine, the ordinary steam plant is often an exceedingly wasteful institution. By centralizing this power—generating it on a large scale for ultimate distribution to the point of utilization—a very material saving may be effected in the cost of operating almost any kind of machinery. Electricity affords us the best possible means of practically applying this system.

Committees of the Master Car Builders' Association.

Following is a correct list of the subjects and the committees for the Master Car Builders' convention to be held next June:

1. Journal box, Bearing and Lid for 60,000-pound cars, and Lid for Old Standard Journal box.—John S. Lentz, F. D. Casanave, R. McKenna, J. N. Lauder, A. A. Jackson.
2. Metal for Brake Shoes.—G. W. Rhodes, B. K. Verbryck, E. B. Wall.
3. Lettering Freight Cars.—E. W. Grieves, G. W. Demarest, R. D. Wade.
4. Steam Heating and Ventilation of Passenger Cars.—J. N. Barr, T. A. Bissell, J. W. Marden, J. C. Barber, W. H. Lewis.
5. Steel Plate and Malleable Iron in Car Construction.—Wm. Forsyth, John Mackenzie, E. D. Bronner.
6. Code of Rules for Interchange of Passenger Equipment Cars.—C. A. Schroyer, R. Kells, J. H. Rankin, J. B. Henney, T. Sutherland.
7. Loading Barks and Logs on Cars.—R. C. Blackall, Wm. McWood, F. D. Adams.
8. On Expediency of a Change in Standard Height of Draw-bars in Passenger Equipment Cars.—E. N. Nelson, John Kirby, H. Middleton.
9. On Place of Meeting in 1890.—R. D. Wade, W. H. Day, G. W. Demarest.

An Indiana man grinds corn-stalks and coarse prairie grass, moistens them with water, reduces them to a coarse pulp and then subjects the mass to a heavy pressure, com pressing them into blocks 12 by 4 and 4 inches thick. These, when thoroughly dry, furnish more heat than ordinary bituminous coal.

The Ohio Falls Car Company, of Albany, Ind., has received a contract to build a half-million dollars' worth of cars for the Central Railroad, of Georgia, consisting of 1,200 freight cars and 22 passenger coaches. This is one of the largest contracts ever received by this company. The contract was closed by Mr. L. G. Mathews several days ago. The Ohio Falls Company now has enough work on hand to keep 2,000 men busy for four months. The company can with a full force turn out 22 freight cars a day and two passenger coaches a week.

At the recent Congress of Locomotive Engineers and Firemen, held at Leeds (England), there were present delegates from every railway in the kingdom. Resolutions were unanimously passed expressing satisfaction at the passage of the Railway Regulation Act of 1889, and urging the Board of Trade to insist upon the use of continuous automatic brakes and the absolute block system upon all railways without delay, directing the attention of the companies to the evils of long hours, and asking for an alteration in the present methods of testing the eyesight of railway men. Further resolutions were also passed as to other grievances, such as the absence of brake power upon fast goods trains, the practice on some lines of causing branch passenger trains to be worked by engines which are run tender first, the injuries caused to enginemen and firemen by the bursting of glass water-gauges (which it was suggested should be protected by a wire casing), and the unnecessary risks run by the men and the public under the trip system.

Car Wheel Making.

At the November meeting of the Northwestern Railroad Club Mr. T. A. Griffin read a paper on "Car Wheels," which was principally devoted to assailing the position taken by Mr. J. N. Barr in the paper he read on "Contracting Chills" last winter at a meeting of the New York Railroad Club, and published in the January number of the NATIONAL CAR AND LOCOMOTIVE BUILDER.

The first point raised was Mr. Barr's statement that "the gray iron forming the body of the wheel should be of medium grain, dark color, a ragged fracture free from imperfections of white iron."

Regarding this, Mr. Griffin says: My opinion and experience are that iron dark in color does not wear well, being too high in graphitic carbon, and that better results will be obtained by an iron neither dark nor light in color, rather a medium between the two.

Then he took up the weeel defects enumerated by Mr Barr, viz.:

"1. Chill cracks.
"2. Rough treads.
"3. Slag in tread.
"4. Sweat and depression at throat.
"5. Irregular depth of white iron.
"6. Too small or too great depth of white iron.
"7. Lack of roundness."

Proceeding he said: Railroads who inspect and test wheels, as they have the right and should do, need not accept any wheels with the above-mentioned defects, and they are all specially described in well-known wheel specifications as reasons for the rejection of car wheels; and, consequently, as users you might say that you were not interested in knowing how these defects were created, nor how they can be avoided. But, Mr. Barr having devoted a large portion of his paper to these defects, which the sole purpose of showing by inference, if not by direct statement, that they would all be avoided by using his contracting chill, and that they could not be so avoided by using any other, I ask your consideration to enable me to analyze the statements of Mr. Barr on this subject for exactly the opposite reason that he used them.

First, chill cracks. Mr. Barr says: "Hot and fast pouring increase the tendency to chill crack; cold and slow pouring prevent them." I admit all the bad effects stated of cold and slow pouring as claimed by Mr. Barr, in his paper read before the New York Railroad Club, but deny the inference, viz., "to avoid all this you will have to use my chill." I deny the statement that hot and fast pouring increase the tendency to chill crack, and its consequent inference. We desire to place ourselves on record with this statement: That we pour iron as hot and as fast as Mr. Barr ever did pour iron into contracting chills, and that our losses from chill cracks are not three wheels in one thousand: in fact, on our last month's report, eight molders out of fifteen—averaging over 500 wheels apiece for the month, and aggregating over 4,000 wheels—did not have one chill-cracked wheel among them; and, further, that the balance did not exceed the statement above (three in one thousand), and that in every single case we could point to a reason for the chill crack outside of hot and fast pouring.

Secondly, rough treads; 3, slag in tread; 4, sweat and depression at throat; 5, irregular depth of white iron; 6, too great or too small depth of white iron; 7, lack of roundness.

In all of these I agree with Mr. Barr that they are defects in car wheels, but deny the inference contained therein, viz., "to remedy them you must use the Barr contracting chill." Mr. Barr having described only such defects in car wheels as he thought he could remedy, in other words, named seven ills for which he recommends one chill (that one being his own) which he claims will cure them all, he then goes on to describe it, and in this description of the chill he states seven things as being the primary benefits derived, which are the remedies for what he states are the seven principal defects in car wheels.

Then follows a lengthened attempt to discredit the statements of wheel mileage contained in Mr. Barr's paper. This is succeeded by a report of tests made by the Hunt Bureau of Inspection and Tests for the Griffin Wheel and Iron Company, of which the following are the most important parts:

Test 1 represents a wheel made in the Barr contracting chill, with steam and water applied in the same manner and under the same directions as followed by the contracting chill people. The chill was first heated to the utmost possible limit, and the cold water was then turned on and the wheel started to pour at the same time. The time of pouring this wheel was 48½ seconds. The only variation in this test of the Barr chill from the regular instructions was in the time taken to pour. The result of this test showed a chill in the throat of the wheel of $\frac{6}{16}$ inch and in the center of the tread a chill of $\frac{1}{16}$ inch. The chill on the companion test piece, which is also marked No. 1, being poured at the same time, out of the same ladle, showed $\frac{1}{8}$ of an inch.

Test 2, also stamped with our trade mark and numbered 11, was made in the Barr chill, and poured under the well-known instructions with steam and cold water in seven seconds of time. Result: Chill in throat of wheel $\frac{1}{16}$ of an inch, and in the center of thread $\frac{1}{16}$, or one inch. The corresponding chill on the test piece poured at the same time, from the same ladle, was $\frac{1}{8}$ of an inch.

Test 3, containing our trade mark, and numbered 111, was poured into the Barr contracting chill in 7½ seconds, no steam or water being used. This wheel showed chill in throat of $\frac{1}{4}$, and in the center of the tread $\frac{1}{8}$, or one inch. The corresponding chill on the test piece poured at same time from same ladle was $\frac{1}{8}$ of an inch.

Test 4. This wheel was cast in ordinary chiller, stamped with our trade mark and numbered 1111, the time of pouring being eight seconds. The chill in the throat and in the center of tread of this wheel was precisely the same, measuring $\frac{1}{16}$ of an inch in each case. The corresponding chill on the test piece poured at same time from same ladle was $\frac{15}{16}$ of an inch.

All of these wheels were poured from the hottest kind of iron, were taken direct from the cupola, the ladles also being hot in each case, one wheel being poured from same ladle in each case, out of each tap immediately before the test wheel was poured.

I have examined the construction of these chills, and the drawings from which they are made and find them in every respect identical with the chill which is commonly known as Barr's contracting chill of the latest pattern. I can also attest to the fact that in each case I was advised as to what object was to be attained in each particular test, it being stated in regard to test No. 1, that pouring the iron slowly into the Barr chill and following all other instructions would produce a lighter chill on the wheel, also a variation in the chill in the throat of the wheel as compared with the center of the tread, which statement appears to be verified by the result.

The difference between test No. 2 and test No. 3 was only the absence of steam and cold water in No 3 as against their use in No. 2, the Griffin Wheel and Foundry Company claiming that they would produce as good a chill on the wheel without the steam and water as they did with it, all other conditions being the same, and the result would indicate they have done so.

Test No 4, a wheel poured in an ordinary, common chill, such as is in use in their (the Griffin Wheel and Foundry's) foundry, was poured with iron just as hot as was the Barr wheel, in eight seconds of time, the Griffin Wheel and Foundry Company claiming that they would produce as good a chill in the throat of the wheel as in the center of the tread, as compared with the results obtained by Mr. Barr with steam, cold water and his contracting chiller.

After reading this report Mr. Griffin said:

You will see, gentlemen, by this report, that every statement which I have made, as opposed to the statements made by Mr. Barr, so far as the results claimed by his contracting chill and the use of steam and water therein are concerned, has been proven to be correct. As further evidence, and for the general satisfaction of those interested, I have brought the original pieces of these four test wheels with me, and you can inspect them for yourselves, and verify the statements given by the Hunt Bureau.

I will say, in explanation of my devoting so much time to that part of the paper read by Mr. Barr, on the subject of car wheels, before the New York Railroad Club, relating to contracting chills, that by referring to the report of the proceedings (of which I have a copy) you will find that the greater part of the discussion in the New York Club was largely confined to this particular subject at the meeting specially called for the discussion of car wheels; and, gentlemen, you will bear in mind that I have confined myself in every single statement, to the statements made by Mr. Barr at the New York Club and that I desire to put myself upon record as never having said that contracting chill wheels were not as good as, or better than, other wheels. I have not sufficiently analyzed the subject to make a positive statement to that effect, but I have said, and I do say, that I believe I have fairly demonstrated that the use of water and steam in a contracting chill is of no practical value, and that good car wheels with uniform chills in all parts can be made in common chills, and that iron can be poured as hot and as fast in one as in the other; and that so far as concerns the claims specifically made by Mr. Barr for the contracting chills as compared with common chills, I have demonstrated that they were not true.

Mr. J. N. Barr said: I have been taken unawares to-night. I didn't want to come here and stick contracting chills at you myself; that is, in a theoretical way. I expect to have contracting chill wheels themselves stuck at you, but not as a matter of theory—as a practical matter for you to try practically, and get results. I am almost compelled to say something here. I won't say anything in my own defence as regards that part of Mr. Griffin's article in which he directly or indirectly—or however you may put it—charges me with dishonesty. About that I have nothing at all to say; I cannot reply to it.

As to the matter of the statements that I made at the New York Railway Club, those are all correct and straight; I hardly think that there is any one here who believes that they are otherwise. The whole records from which these statements were made are still in existence at Milwaukee, and if any one is sufficiently interested in them I shall take great pleasure in showing them. That is all that I have to say on that part of the subject.

As to Mr. Griffin's test here I think that I ought to say a few words. He shows two tests. He shows two tests poured in the contracting chill, the time of pouring being something like 40 and 7 seconds.

Mr. Griffin: The first test was made in 48½ seconds, and the other two in 7½ seconds.

Mr. Barr: Now, Mr. Griffin, a practical wheelmaker knows that the 40-second business is what makes the low chills; and to have shown you a complete comparison between the contracting chill and the ordinary chill he should have shown you a wheel poured in the common chill in 40 seconds out of the same metal.

Mr. Griffin: I am willing to waive that discussion. Had I poured it in the common chill I agree that it would have been identically the same as it would have been in the contracting chill.

Mr. Barr: Then we will infer that this has no relation to the comparison between the two chills. It is understood that this case of 40 seconds pouring into the chill on the wheel is materially below the chill test.

Mr. Griffin: Read the report of the expert. It was claimed that by pouring it in 40 seconds the chill would still be light in the tread of the wheel, and the result verifies the statement.

Mr. Barr: The other two tests show good results, and show a chill on the wheel almost or quite equal to the chill on the chill blocks. The fourth test, in the common wheel, shows a chill on the chill test of $\frac{15}{16}$ of an inch.

The chill on chill test No. 4, which corresponds with exhibit No. 4, showing a wheel cast in the ordinary chill, is about $\frac{15}{16}$. The depth of white iron on the wheel, measuring at the highest point, is a little over $\frac{7}{8}$. Now, that is just exactly what I claim for the contracting chill; that is, that the chill on the wheel is very nearly equal to the chill on the test—that you don't need to make a high mixture, chilling an inch deep on the chill test to get a good half-inch on the wheel; and you all know how much the strength of a wheel depends on the hardness of the metal that is used in forming the body. That is one great trouble with the common chill; you cannot use a low, tough grade of metal in the common chill and get a good chill on the wheel. If your chill on the wheel would equal the chill on a block like this, then you could use a lower grade of metal and make a much tougher and safer wheel. Now, any chill that will chill the wheel as it is on the chill test—if you could get such a chill—you will all agree, will make the best wheel. Mr. Griffith makes a point here that in these particular cases steam and water were not used.

Mr. Griffin: In one, of course; in the other, it was not. I would like to ask Mr. Barr how he accounts for the fact of the chill on the one which did not have the water and steam is equal to the one that did?

Mr. Barr: I have simply to say, with reference to that use of steam and water, that I used a chill for a year without steam and water and got a good wheel. I didn't get as deep a chill on the wheel, as a rule, as on the chill test—in fact, considerably below it. I felt that until I produced a chill on the wheel as deep as the chill on the chill test there was something failing in the device. I therefore went ahead to devise some method of giving an additional movement of the chill blocks.

(Mr. Barr here drew a diagram on the blackboard to illustrate his remarks, describing the Barr chill.)

Suppose that to be a ring of metal of the proper shape to form—on the inside—to form this part of the tread of a wheel. That is a car-wheel chill. You pour the moulten metal against that chill, and a shell commences to form against it. As it forms the chill becomes heated and expands. The solid, thin shell of metal which forms against there still continues to cool and necessarily to shrink. The shell on the inside in that way is separated from the chill and the cooling effect of the chill is stopped. That accounts for the fact that in the ordinary chill you don't get as much depth of white iron in the wheel as you do in the chill test. Now, my first object was, or my first idea was, to destroy the expansion of that chill. I thought I had it then; so I simply cut it in that way all round (indicating), leaving a ring outside here carrying those blocks. I felt then that the metal in here would be sufficiently cool; or, in other words, that the chilling operation would be completed before the heat could pass through these blocks into the outside ring. That did a great deal of good, but working it day in and day out on a floor of wheels, I found that still the depth of white iron on the wheel was materially less than the depth of white iron on the chill block or chill test. Then I got quite an elaborate device to make a chuck that would move all these blocks (96 of them) in against the wheel as it contracts on the inside. I never made that machine because it was too expensive. I concluded to secure that movement to a limited extent by connecting with an outside ring—running the cuts right through the chill and making a little connection. Now is obtained an outside hollow ring that is carrying these chill blocks in the proper position to form the tread of a wheel. To give them motion, I pass steam in, heating up this ring, and, of course, as it expands it must carry these blocks with it and increase the diameter of the inside, or chilling surface, of the chill. Then when pouring the metal I turn a current of cold water through this ring that causes these chill blocks to move inward. Now, it has been said it does not move more than about a twentieth of an inch. I know it, and I never said that it did. I have tried it a hundred times. I have made a chill with these blocks connected by an arm and an outside hollow ring six feet in diameter. You can very readily see that that will double the motion of the chill blocks, double the contraction of the chill; and on that chill I had so much contraction that I would squeeze the metal out of the hollow where the single and double plates unite. I concluded that I had more than was necessary. Whether we have, or not, more contraction than is necessary, there remains the fact that we almost invariably get a uniform chill on the wheel and a chill almost as deep as on the chill test. Now, if that don't make the action of the contracting chill clear, I would be glad to have any members of the club ask any questions about it, so that we can settle that in our minds. I am not saying now that it makes a better wheel; I am simply trying to present to you the action of the contracting chill.

Mr. Griffen: If the action of the water controls those pieces in their inward motion, I will ask how you account for the fact that a wheel that has taken 48 seconds of time to pour shows only half of the chill in the throat that it does in the center of the tread?

Mr. Barr: The question is why this chill, poured in 48 seconds, shows less chill in the throat than in the middle of the tread. You are all doubtless familiar with the formation of this sweat or beads in the throat of the wheel; and, if you observe the wheel closely, you will find that there is a depression right in the throat. If you make a template of the chill and apply it, you will find that it will fit along the tread and against the flange, but close in the throat there is a depression. When you look at the white iron on the chill you find that it is lower in the throat than any other place. Now, I would say that the reason that that is lower there than in the tread is imply because it was poured so slowly that the flange here had set and started to contract before ever the wheel was poured, and carried the shell of metal in the throat away from the chill, and stopped the chilling operation. It is unquestionably the cause of it.

Mr. Griffin: Then, do I understand, Mr. Barr, that the limit of the value of the contracting chill with water and steam is based simply and solely upon fast pouring?

Mr. Barr: I scarcely see how you can understand that from what I have said. You show us a wheel here that is poured in eight seconds and has about 30 per cent. less chillon than the chill test, showing the chill of the metal from which it is poured. You show us a contracting chill here that is poured in the same time and has as much white iron in the wheel as on the chill test. They were both poured in the same time. What makes the difference?

Mr. Griffin: I admit that it was not under fair conditions that I poured that wheel; it was 48 seconds—it was not your rule. Do you consider that the value of your contracting chill is based on the fast pouring of it, or not?

Mr. Barr: It certainly depends on that, yes.

Mr. Griffin: Is there sufficient power in the water and steam to control it if the molder is careless and takes too much time?

Mr. Barr: If you pour a wheel and don't take advantage of the contraction of the chill, it is going to be a poor wheel. The best arrangement in the world can be ruined if it is not used right.

Mr. Griffin: Why is it that the chiller without the water produces as good a chill as with it? Here is a test that says that it does.

Mr. Barr: I say, absolutely, it does not. I have made hundreds of tests in which it did not show it. I can pour a wheel in the ordinary chill, and you can find some place on that wheel that is nearly as deep as the chill on the chill test. I would say this, as the result of continued tests between using the water and not using the water in the same make of chills, that the depth of white iron is about 20 per cent. greater using the water than not using it. Now, I don't say that I can demonstrate that on one wheel. I can't say to you "If you come to the foundry I will show you on two wheels that if we use the water on one the chill will be 20 per cent. more than on the one on which we don't use the water"—I can't say that. But I say, as an average, running the two for a month, that there is a difference in the depth of white iron of 20 per cent. in favor of using the water.

Now, this whole discussion don't really amount to very much. It is theoretical, and practical men know that theory is often very lame, and cannot be made to gibe with the practical results that you get in service The way to settle this question about contracting chills and the common chill is to simply take some wheels, put them in the same service—say equip one truck with contracting chill wheels and one truck with the common chill wheels—and let them run and tell their own story. Now, that is what I expect all of you are going to do some time, because you will all have an opportunity to try some. There are four firms making wheels in contracting chills now, and there will be more shortly; and I presume that some of these firms will be after you to try some of these wheels And I would rather let the decision as to the relative merits of the contracting chill wheels and the ordinary wheels rest on a test of that kind, and let it talk for itself. If I stood here and talked to you all night about contracting chills, I do not believe that you would know a bit more about it, or that you would have any sort of an idea that it was a better wheel than you have now.

Some further discussion ensued, which was participated in by various members of the club, but no point of general interest was brought out.

A single locomotive of the Pennsylvania type recently made a trip of 471 miles with a heavy train behind it. This is the longest continuous run ever made by a locomotive.

Commercially, the pine woods of Georgia are probably her most important resource. They are almost inexhaustible, and of a superior quality to those found further up on the Carolina coasts. As soon as the large saw mills denude one section of the country they move to new districts, and they begin operations again. Young pine trees spring up at once all around the stumps of the old ones, and in five years they are ready to be tapped for turpentine. This does not materially injure the trees, and they continue to grow into large timber while the turpentine farmers are making a good living from an abundant flow of sap. In 15 or 20 years the trees are ready for the woodman's axe again. Thus they actually grow faster than they are cut down.

Compounding Old Locomotives.

At the November meeting of the Western Railway Club, President Hickey in the chair, the following paper was read by Mr. E. W. M. Hughes, locomotive superintendent of the Northwestern State Railways of India:

I have given much thought to the compounding of locomotives, not in the direction of newly designed engines, but to the practical advisability of converting existing engines into the compound system.

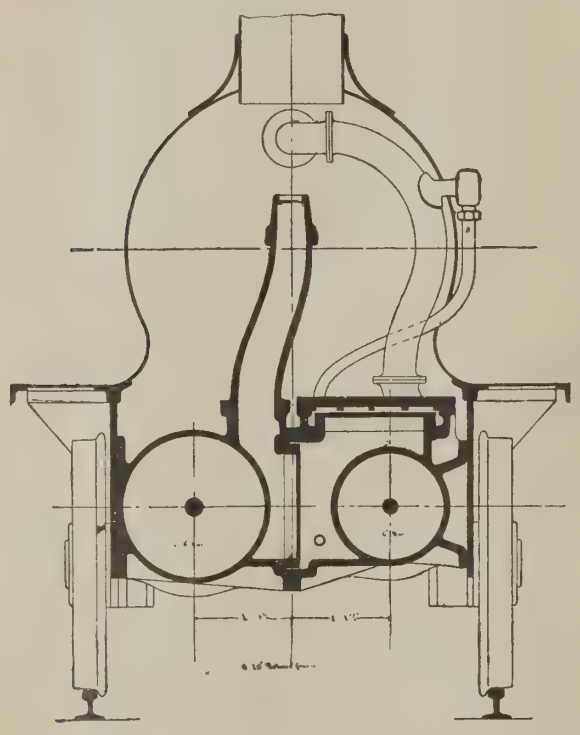
If compounding is to be of any good to a railroad, it requires the converting of the whole stock of engines. The saving to be made in only new engines having the improved method would be but small to a road, and not of any appreciable value. I therefore consider that the most important points to be considered are: Can we at a small cost convert our ordinary high-pressure engine into a compound, and in so doing make an actual gain to the owning company that would justify the time and money laid out?

Early in 1882 I determined to make my experiments, but was prevented from personally supervising the work owing to the extra duties thrown upon me in connection with the moving of troops into Afghanistan. The trials were, however, carried out to my idea on the lower sections of our roads that were within the frontier limits of India, and these trials I will now describe.

Two old engines requiring heavy repairs were taken into the shops, and upon these the alterations were made. Both these engines required new cylinders. Each had 3-foot 6-inch leading wheels with two pairs of 5-foot wheels coupled with cylinders of 16 inches diameter and 24 inches stroke. In one of these engines the old 16-inch cylinders were replaced by an 18-inch high-pressure and 24-inch low-pressure, these being as large as could conveniently be placed between the frames. The slide valve of the low-pressure was worked direct as before, but that of the high-pressure through the intervention of a rocking shaft. Excepting this slight modification thus rendered necessary, the gear remained the same as of old. This arrangement gave excellent results in working. To meet any contingency of the high-pressure cylinder sticking on a dead center, a valve was provided by which steam was admitted direct from the boiler into the steam chest of the low-pressure cylinder.

This engine was regularly employed on freight service, and hauled 550 tons at the rate of 22 miles per hour, and consumed 13½ per cent. less fuel than an ordinary one of its own class.

The other engine altered was of the same class. It was changed to a four-cylinder compound, having a pair of outside high-pressure cylinders of 11¾ inches diameter, and a pair of low-pressure inside cylinders of 17 inches. The original 24-inch stroke was retained for all four cylinders. The crank pins for the high-pressure cylinders were fixed opposite to the cranks of the low-pressure. The results obtained from this engine were identical with those from its sister engine above described. It was a better steaming engine than the two-cylinder locomotive, but the latter was never short of steam.



The compounding of those two engines was a decided success. They were more powerful than in their original state, and showed a decided saving of 13½ per cent. in fuel.

They were nothing new for the engineer to handle, and any engineer could drive them without special study.

Being old boilers, the working pressure was only 120 pounds per square inch. With a higher pressure a much better result would have been attained. The conclusions I have come to from the performance of these two engines is, that it is quite possible to convert the ordinary high-pressure engine into a compound at a reasonable cost with a decided advantage. I prefer two cylinders to four for the simple reason that it is far less complicated and less expensive. I consider it is a mistake with three-cylinder engines to leave off the coupling rods, as the wear, however little, from them will be more than counterbalanced by the unequal wear produced on wheels revolving at different speeds.

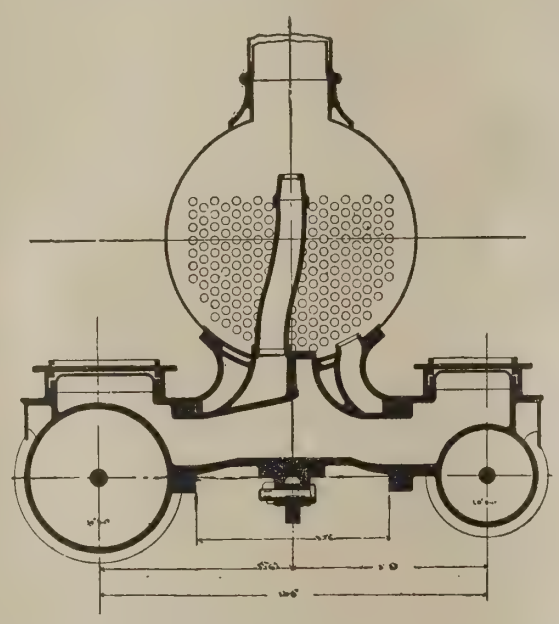
I show an outside cylinder engine (American type) with a pair of compound cylinders, and shall be glad to see some of our members take up the matter on these lines and give it an actual test. My experience shall be at his disposal, and I am confident the trial would result in economy to the company and a valuable experience to the profession generally.

I think much aid could be given to compounding by some suitable means of jacketing the cylinders. It is a difficult matter to steam jacket a locomotive's cylinders as they are carried so much below the water level of the boiler, thus making a proper drainage of the water from the jacket almost impossible. I do not see why a portion of the smoke-box gas should not be conveyed round the cylinders. I feel certain that a good system of jacketing the cylinders would lead to at least 8 to 10 per cent. higher economy in fuel.

In the discussion that followed the reading of this paper it was brought out that the changing of the two-cylinder locomotive cost about $200 and the four-cylinder engine about double that amount. The engines had been run by different enginemen, and all were interested through the premium system in using as little coal as possible. The saving ran from 13 to 15 per cent. with the compounds.

The discussion was participated in by Messrs. Hughes, Rhodes, Setchel, Lewis, Gibbs, Little and others.

Mr. W. Forsyth said: I believe thoroughly in the compound principle of locomotives, and I think the way for American engineers to start out to solve the problem is the way Mr. Hughes started in India; that is, to take the frame as it is and adapt it to the compound engine. I was wondering whether Mr. Hughes would say anything about the receiver. I noticed the volume of the receiver in his plan there was very small, and was pleased to find that he afterwards used the proper pipe in going around through the smoke box. There is no doubt that is the correct principle, and there is a real advantage in getting dry steam and economy in fuel in the use of it. This subject is in its infancy here, as we all know, and I believe after we get thoroughly into it and commence building compound locomotives that we shall all be surprised that we have waited so long to start it. When in Manchester, England, this summer, I found that they were almost entirely engaged in making compound locomotives. At one place I think they had on the way forty compound locomotives; most of these, however, were for the colonies and for distant foreign countries where fuel was expensive. In England the principle is gaining ground, although it is rather amusing and surprising to find the roads under very intelligent management in the motive power departments differ so widely on this question. One of them was running compound engines successfully and showing a very appreciable improvement in economy, while another one seemed to have no belief in it whatever, and didn't think it worth while to take it up. This, I think, is more a matter of personal feeling than of scientific fact, for I think every intelligent engineer who studies the question of the distribution of economy of steam in the locomotive will find that we have about reached the limit of maximum economy with the simple engine, where we use the steam once and then throw it away. The advantages of the compound engine have been explained here and in the papers pretty thoroughly, and among others I think ought to be emphasized the fact that we expect to get more power out of the locomotive at high speed. That is the weak point of the simple locomotive for passenger service. I do not know whether I should try to explain why—it is rather difficult without using figures and diagrams—but the fact that with the compound engine you can get a very much larger opening of the exhaust nozzle and a draft with the large exhaust nozzle reduces the back pressure so that at a large cut-off you can get a larger area of diagram at high speed than was possible with the simple engine. Another advantage is the more uniform pressure on the crank pin. The difference in the pressure each side of the piston in each cylinder is very much less than in the simple engine, and the consequence is that there is a more uniform pressure on the crank pin and a more uniform stress throughout the machinery. Mr. Barnes discussed somewhat the means of obtaining sufficient power in starting, and referred to some of the valves which were in use. That is a matter for which I think each individual designer will have some preference of his own; it can be shown, though, I think, that it is quite possible to control the steam in the low-pressure cylinder, and obtain as much pressure there as we desire. In regard to Mr. Hughes' figures, the economy which he claims is a little higher than I should expect from the use of the compound without any increase in the boiler pressure.



The President: Mr. Hughes' remarks regarding jacketing the cylinders will apply to simple engines as well as compound. I think a great many of our engines lose much in the exposure in which our cylinders are placed. We are generally not particular enough in protecting the steam that enters the cylinder, and consequently we have much more condensation than we otherwise should. A simple means of admitting steam to pass around the cylinder would be a great advantage. The suggestion is worthy of great consideration.

Discussion on compound locomotives closed.

Metal for Brake Shoes.

The following paper by Mr. Case, of the Hannibal & St. Joseph Railroad was read at the November meeting of the Western Railway Club:

It appears that the question "What is the best metal for Brake Shoes?" is one to which very little thought has heretofore been given by railway men in general; we, therefore, beg your indulgence while we enter into the question more minutely than would otherwise seem necessary.

In the use of brake shoes three forces are noticeable: 1st, the momentum of the wheel; 2d, the pressure used in the application, and these two produce the third force, viz: friction, which acts as a retarding force to the first.

The first cannot be controlled, and in the second we are limited by the weight of the car, or engine, and by other circumstances which make only a certain force permissible for the well being of the journals, bearings and boxes, and, owing to this, the less force used to produce the required friction, the better all interests are served; hence it behooves us to find by some process of experiments or reasoning from known facts, that metal which will produce the greatest friction in a given time by the application of a reasonable pressure.

Whenever friction is produced, it will be found accompanied by a wearing away of the parts producing it, in fact, friction may be said to be measured by the force required to detach and remove from the larger bodies the small particles that are worn off; hence where all the conditions remain the same, the greater wear, the more friction produced.

It needs no argument to prove that particles can be detached or worn off from a brittle metal with less force than from a tough metal: therefore, it is plainly apparent that for friction, a tough metal is needed. Tough metals however, may differ in point of hardness; therefore the next question would naturally follow: How hard should we have it?

It should be borne in mind that two forces are necessary to produce friction, one that brings the two surfaces in contact and the other, at a right angle with the first, causes the separation; and that the friction is measured by the latter force. If a file be applied on soft metal it is found that a strong force is necessary to push it under a light pressure, while on hard metal it can easily be pushed under a greater pressure; thus it is clear that on a soft metal a greater friction is produced than can be on a hard metal with the same pressure.

It cannot be doubted but that in removing a given quantity from a hard tough metal a greater quantity of friction will be produced than in removing the same quantity from a soft tough metal, but it will require longer time and greater pressure to do it.

A train must be stopped in a given time, which requires a certain amount of friction to be produced in that time. Hence a metal is needed soft enough and tough enough to produce that friction in the given time under the limited pressure that can be used. Therefore, to meet the requirements as to friction, it would seem that the metal selected should possess those qualities characterized as soft and tough.

This statement would seem to be verified by the experience of a representative of the Westinghouse Air Brake Company, who stated at the last meeting of this club that he had recently been called to examine the braking apparatus on a train that was reported as not "holding," and that he found no trouble with its "holding" after he had removed the hard shoes in use and substituted soft cast-iron shoes; in other words, the hard shoes would not produce the necessary friction in the required time under the limited pressure permitted, while the soft ones did.

In applying brake shoes another effect is noticeable, namely, heat. Under continuous or frequent application of the brakes it will be found that the temperature of the metals producing the friction rises very high; in fact, upon mountain roads it is found necessary to stop occasionally to cool the shoes and wheels.

When heat is used as an agent and held under control it is a valuable force. but whenever we have heat in a high degree that is not produced for a specific purpose it is invariably accompanied by undesirable results. Let us see if we cannot find it so in this case. In working iron it is found that the hotter it gets the easier it works whether under hammer, file or tool.

When it is considered that a steel tire is being constantly rolled under heavy pressure, it can readily be seen that every degree of heat added to its temperature increases its liability to become loosened, both from the rolling process and expansion, coupled with the frictional force which is applied in such a manner that would, were it great enough, cause the tire to revolve on the wheel. We believe that the loosening of tires is due wholly to the excessive heat generated by the application of brakes or cutting of journals.

This excessive heat also has a tendency to destroy the chill of the wheel and thereby cause it to be more easily flattened when skidded, as it naturally wears faster after the chill is destroyed.

Manufacturers of chilled wheels claim that it is dangerous to bring the temperature of a chilled wheel up to 300 degrees, particularly because of their liability to crack by rapid cooling from that temperature. It can readily be seen that there is some foundation for this statement from the fact that in the process of casting chilled wheels they are, while still hot, taken out of the chill and lowered in a pit where they remain covered two or three days to prevent the rapid cooling. And again, with steel tires it is found they invariably get so hard that it is almost impossible to turn them up; the cause can be traced to the same agent, heat. While there are other and better agencies for the purpose, yet atmosphere will absorb heat rapidly enough to harden steel, and what is commonly called case-hardening of tires is undoubtedly the effect of rapid cooling after the application of the brakes.

Again, if the metal for the shoe be of the proper character, waste commences from the first revolution of the wheel, because with every revolution the metal gets hotter and the particles are removed with less force, hence greater wear is required to produce the same friction. We are, therefore, led to state that if friction could be produced without heat we would avoid all the undesirable effects arising from the application of the brake shoes. This cannot be done, but this heat can be held in check.

Heat begins to travel, and is continually in motion from the time it is generated until it disappears. Philosophy teaches that when two metals come together in frictional contact, a separate and distinct current is set in motion in each, one traveling in opposite direction to the other, and contrary to the movement of the body in which it circulates. There is also another movement of this heat, namely, the absorbing of heat by the atmosphere; otherwise, it would be absorbed as fast as generated.

With the first revolution of the wheel the heat and friction are commensurate, but with each succeeding revolution the heat is accumulated, and this accumulation is in multiples less the amount of radiation which, increasing with the accumulation, finally equals the generation. A part of this radiation, however, goes to the wheel instead of the atmosphere. The wheel, being the larger body, keeps cooler in proportion than the brake shoe, and iron being a better conductor than air it necessarily absorbs a portion of the radiation from the shoe. Hence any device that will keep the temperature of the shoe down will likewise affect the wheel in proportion. To hold this heat in check it is necessary to destroy, as far as possible, the conducting properties of the shoe. We find that this can be done by inserting in the face of the shoe a soft metal or alloy, which, being a very poor conductor of heat, has the effect of breaking the current, and the temperature of both shoe and wheel are thus held nearer normal, and in the proportion that this is done the wear of the shoe and wheel is reduced, and the undesirable effects, the cause of which has heretofore been traced directly to the high temperature of the shoe and wheel, are avoided.

We have made some tests for the purpose of determining to what extent this heat could be held in check, with the following results.

Under additional circumstances the actual heat generated in a cast-iron shoe was 560 degrees, or nearly four times that of the composite metal shoe, which was 145 degrees, and in the wheel under the cast-iron shoe 195 degrees, or more than double that of the wheel under the composite metal shoe, which was 95 degrees. The normal temperature at this time was 65 degrees, which should be added to the above figures to obtain the actual temperature reached by each. We have also made many stops with the composite metal shoe in com

parison with the cast-iron shoe, in which we found that we could stop in as short time and distance as with the ordinary cast-iron shoe.

We have made some preliminary stop-tests with cast and wrought shoes to determine the relative friction and wear under varying circumstances, and while as yet we have no accurate statistics to offer, we have learned enough to convince us that practice will demonstrate the truth of the foregoing statements.

We have found that the wear of the cast-iron shoe is greater as the heat rises, without any increase in friction, and have also found that the wrought shoe will show much less wear than the cast shoe, but at the expense of far greater wear on the wheel, so much as to be an impracticable metal for brake shoe purposes.

We then recommend a soft cast-iron shoe with a softer metal than the body inserted in its face.

Mr. G. W. Rhodes asked how the temperature of the wheels was taken, and how the friction of the shoes was found.

Mr. Case: A set of cast-iron shoes was put upon a coach and also a set of composite shoes, and a run of several miles was made on the road with the brake pressure on each truck being alike, and at various stops the temperature of the shoes and wheel was taken with a thermometer. In regard to the other question, a machine was arranged in the shop wherein the frictions of the shoes were measured. We have only been running this machine during the last four or five days, and we have not arrived at results which should constitute an accurate comparative test, but have learned sufficient to know that the friction does not increase under the cast-iron nor the wrought-iron shoe as the heat generates.

Mr. Driggs (Composite Metal Shoe Company): We had a small shoe constructed that could be brought to bear by a spring pressure equal at all times, and the friction was weighed at the time of starting and weighed again at the expiration of 2½ minutes, and the temperature taken. The thickness of the shoe was measured to the one-thousandth of an inch. We found that in a run of two minutes and a half the shoe had worn away about nine-thousandths of an inch and the temperature had run up between two and three hundred degrees. At the expiration of five minutes the temperature had increased somewhat, and the wear was from three to four times as great as it was in the first 2½ minutes. The machine was kept running up to 20 minutes, and the same proportion of wear held out as the temperature rose.

Mr. Snow: We always used a wrought-iron shoe up to a couple of years ago, and had very good success. We tried cast-iron shoes and also several others, and the wrought-iron shoe beats them every time. My experience is that a wrought-iron shoe will outwear about eight cast-iron shoes. The Congdon shoe comes up pretty close to it, but it does not beat it. We use a cast-iron shoe on the steel-tired wheel.

The President: Mr. Snow, you said the wrought shoe would outwear about five to seven times that number of cast shoes? Do you base this on the same number of square inches in contact with the wheel?

Mr. Snow: What I mean is, we put a cast-iron shoe on one end of the brake beam and wrought-iron on the other. Yes. Our wheels run from fifteen to thirty days on these suburban trains with a wrought-iron shoe, and a cast-iron shoe will not last three days, and sometimes will not last more than a trip out to Englewood and back.

The President: What are the evil effects of wrought iron, if any, on the steel tires?

Mr. Snow: We found that wrought-iron shoes wear away the tire too fast.

Mr. Driggs: I took a wrought-iron shoe that was 4 inches long by 1 inch wide, and ground it down to a bearing; before we made a test with a pressure of about 400 pounds, and wore it down to a bearing, but found about as much worn off the wheel as off the shoe. We also found that the heat generated by friction under the wrought-iron shoe was very much in excess of that under the cast-iron shoe.

Mr. Rhodes: This paper has brought up points which we have not considered as carefully as we might before. Now, on the part of the Master Car Builders' Association Committee, I will say that we expect to go to work very soon. We expect to hold a meeting in Chicago on Wednesday, Dec. 18, the day following the Western Club meeting. The committee propose to extend an invitation to the different representatives of brake shoes, and ask them to meet with the committee for the purpose of discussing what should be proper tests for brake shoes.

An important point, of course, to be brought out is the temperature of the shoe at different times during the stop, and also it is important to determine the friction at different periods during a stop. I am a little surprised at a statement in this paper that the tests that were made show that the friction of cast-iron shoes did not increase as the heating increased. I am in hopes that the representatives of the different shoe companies will all give the matter some attention between now and next month, by helping the committee with suggestions, and that we will be able to show the true value of the different shoes, both in their capacity to retard trains and for wearing, and their values in dollars and cents.

The President: It looks reasonable to think that the friction would not increase as the temperature decreases. It is generally supposed as a box or bearing heats it increases the friction, and, of course, it is a fair supposition that a wheel and a shoe would do the same.

Mr. Briggs: We think that the friction does not increase as the shoe gets hotter. We had one test where we run the temperature of the shoe up to over 400, and the friction remained at 135 pounds all the way through from the starting of the machine until it was stopped. We had one case, the very first test we made, where we thought the friction increased as the heat increased; but we found afterward that we hadn't the shoe down to a bearing when we started, and it was found out that the friction increased by reason of the increased surface that came in contact with the wheel. We also found that the friction, as compared with the pressure, was greater under slow speed than under a higher speed. We also found that the co-efficient of the friction was greater under a light pressure than it was under a heavy pressure.

Mr. Cleaver: I know a wrought shoe is very durable and the cast-iron shoe is not. The comparison is about as a week is to six months, as far as the wearing was concerned. As I understand it, the more metal wears off the more friction. What is claimed for the soft shoe here to-day is that it produces more friction and less wear. It seems to me there is a conflict there.

Mr. Forsyth: I have been waiting for somebody to dispute the philosophy that has been offered here in explanation of the results obtained. The use of anti-friction metal to produce friction in a brake shoe is certainly a paradox, and the philosophy which is offered here to sustain that paradox is not sound. I do not believe that this soft metal is a practical thing for a brake shoe, and there are two simple reasons for objections to it. The one is that brake shoes when worn are blue, indicating a temperature above 900 degrees, and it shows that every brake shoe has attained that temperature; so that if this soft metal at a low melting point is used in brake shoes it will be melted out before any great braking power is attained. Another result from the use of soft metal would be the accumulation of sand bedded in this soft metal, which would make the shoe act like a piece of sand paper, and wear the wheel away very rapidly. The results which have been reported here I do not consider of any value, because the fact of putting a bulb thermometer on a brake shoe in a current of air that is liable to be variable in the wind cannot give accurate results.

The reports on temperature are not of much value because they give a comparatively low temperature, and the very fact that that metal would melt out at a practical temperature obtained in railroad practice has prevented them from carrying the experiments far enough to obtain any information which is valuable on the high temperature.

Mr. Snow: We have tried mixing steel when casting. We have made them a little harder and have found that they were a little better than the others.

Mr. Driggs: It is true that a hard cast-iron shoe may reach a very high degree of heat, and as we found in our experience, there is no more friction at that degree than there is at the start. The heat that is in the shoe at that time is not the result of the friction that is being produced at that time, but it is an accumulation of heat that we are striving to prevent. We do not claim to prevent the generation of heat, but to prevent the accumulation of it.

Mr. Forsyth: I claim that the method of preventing that accumulation is not explained in this paper on sound principles. There is a theory there presented about counter-currents I have not seen, and I defy any one here to find it in any scientific book. The paper says that the philosophy teaches that; but this is a philosophy that is not contained in any of the text books.

Meeting of Mechanical Engineers.

The fall meeting of the American Society of Mechanical Engineers was held in the society's rooms, Madison avenue, New York, beginning Nov. 18. The following papers were read and discussed: "Indicator Rigging for Compound Engines," by F. W. Parsons, Elmira, N. Y.; "General Solution of the Transmission of Force in a Steam Engine," by D. S. Jacobus, Hoboken, N. J.; "Street Railway Car Gear for Modern Speeds," by S. J. MacFarren; "The Comparison of Indicators," by J. B. Webb, Hoboken, N. J.; "How to Use Steam Expansively in Direct Acting Pumps," by J. T. Holloway, New York; "Cost of Steam and Water Power," by C. T. Main, Lawrence, Mass.; "Graphical Analysis of Reciprocating Motions, by Oberlin Smith, Bridgeton, N. J.; "The Cards from the Pawtucket Pumping Engine, with and without Jacket," by J. E. Denton, of Hoboken, N. J. W. H. Bristol, of Hoboken, read a paper on, and presented to the society for inspection, "A New Recording Pressure Gauge." Professor Denton then read and illustrated by lantern slides a paper "On the Performance of a Double-Screw Ferry-Boat."

A resolution was passed in favor of holding an International Exposition in 1892, although the president of the society, Mr. Henry R. Towne, wished the exhibition postponed for two years.

A very important step taken at this meeting was the action on the report of the Committee on Standards. It was amended so as not to commit the society to any particular standards, and was then passed. A committee, consisting of J. W. See, Coleman Sellers and P. R. Voorhees, was appointed to bring this matter before Congress, and ask for the establishment of a bureau where recognized standards may be registered. Action was also taken looking to the formation of a federal council of the four engineering societies of the United States, which include in their membership about 4,500 civil, mining, mechanical and electrical engineers. This council would represent the societies in all matters of general interest.

The next meeting of the society will be held in Cincinnati, beginning May 20, 1890.

Improvements in Electric Train Lighting.

Mr. A. H. Bauer, manager of the electric lighting department of the Pullman Company, has just completed the electrical equipment of the "Montezuma" special, a train of four improved Pullman vestibuled cars that are now on exhibition in Chicago, preparatory to being taken over the "Monon Route," via Louisville and Chattanooga, to New Orleans, and thence to the City of Mexico.

Mr. Bauer has placed 39 sixteen candle-power Edison lamps in the "Superb," arranged on two distinct circuits, termed the "end circuit" and the "body circuit," running directly from the cells to a switch and cut-out case placed within a convenient locker, and holding the four safety strips. This arrangement permits of easy and economical handling of the all-night lights in the vestibule and toilet rooms. Each lamp is also supplied with a key socket, so that a particular light may be turned down by the occupant of a berth, while in the corner of each section silvered thimbles have been placed, in which may be inserted a portable lamp with frosted bulb connected to the branch wires by means of a flexible silk cord, the terminals of which are inserted into sockets placed in a rosette above the section mirror, thus affording any desired angle of light should the occupant prefer to read while reclining. Mr. Bauer has so placed the lamps in the composite car and in the dining car that the light falls directly from above and over the shoulder of the tourist, while fans revolved by electric motors are furnished when desired by invalids or others, the motor being connected in the same manner as the portable lamp.

The electric current is supplied by two sets of storage batteries placed underneath and on each side of each car in the train. The new type of cell, 23 M, made by the Electrical Accummulator Company, of New York, is employed, and it is charged with current from an Eickemeyer dynamo, driven by a Brotherhood engine. This plant is placed in one corner of the composite car, and includes an automatic lubricator holding two gallons of oil, steam gauge voltometer, ammeter and a Schaeffer & Budenberg tachometer, as furnished on all the Pullman trains. Speaking of the excellent service given by the Eickemeyer dynamo and of the slight attention required, Mr. Bauer stated that the machine now in service had been run continuously for five months with an overload, and yet there had not been the slightest sparking at the brushes or trouble of any sort. The present machine gives 90 volts and and 85 ampères at exactly 850 revolutions. Mr. Bauer will accompany the Montezuma special on her maiden trip as far as New Orleans, and probably through to the City of Mexico and return.

Mr. Bauer lately referred to the question asked by Mr. A. L. Lang at the meeting of the railroad telegraph superintendents regarding the belting of the dynamo to the axle, and stated that a thorough experience under various conditions had demonstrated the impossibility of securing even fair results in train lighting where the power was supplied by the axle, owing to the constant change in speed and the numerous curves found on American railroads, around which the wheels will often slide without turning the axle a single revolution, thus playing the mischief with belt and armature. But Mr. Bauer said that such a method was employed by Mr. H. O. Houghton in securing current for the train lighting on the London & Southwestern Railway in England. During a trip over that line Mr. Bauer was impressed with the conditions tending to make the system a success, and which are widely different from those prevailing in this country, in the almost entire absence of curves and the high and constant speed maintained. When the speed does vary, an automatic switch placed near the dynamo cuts out the cells, which are not distributed under each car as in the Bauer system, but all are placed in the baggage van.—*Electrical World.*

An important railroad decision was rendered in Pittsburgh, Pa., in September, by Judge Ewing in the Common Pleas Court. L. D. B. Reese was expelled from a train on the Pennsylvania Railroad because he refused to pay the 10 cents extra for cash fare, the money to be refunded at any office of the company on presentation of receipt. The judge held that the 10 cents extra was wrong and so instructed the jury.

The report of the Executive Committee of the American Street Railway Association, at the Minneapolis Convention, contains the following significant paragraph: "During the last few years, each succeeding year has seen electricity progress far more rapidly than any other power that has come to our notice; and this has been especially so in the organization and operation of new roads. To no one department of our business has so much attention been paid, during the last year especially, as to that of motive power. At best, we have come to regard the street railway as a machine by which horses are too rapidly used up; and for reasons of humanity, if for no other, the managers of street railways feel that they should do all in their power to substitute some other motive power for that of animals. If, and when, it is practicable to do this at a much less cost, to say nothing of the greater satisfaction in operation, it is manifestly our duty to do so."

The following editorial note from the Philadelphia *Ledger* gives emphatic expression to views we have been urging upon the railroad companies concerned for the last year or two:

The approach of another winter is signalized by another railroad wreck in which the car stove figures as the chief agent of death. Promises have been made that the car stoves should be abolished; they have been removed from trains running through States prohibiting their use, and special merit is claimed for the steam-heating apparatus employed on other first-class trains. It is thus demonstrated beyond a doubt that steam-heating is practicable, yet the car stove is allowed to remain in some passenger cars, wherever the law leaves it undisturbed. The accident at Pittsburgh should admonish legislative bodies, as well as railroad companies, that something more is needed than talk about the possibilities of steam heating.

It is high time that the legislatures of New Jersey, Pennsylvania and other States were putting pressure upon railroad companies to provide safe means of car heating. The policy of non-interference has been pursued long enough with the companies that display no disposition to dispense with the deadly cast-iron stove. There are hundreds of crowded passenger trains heated with the worst type of cast-iron stoves, daily running on crowded lines where no proper provision is made to prevent collisions. Every day crowds of people are in imminent danger of being cremated in the fires that would be certain to follow the smash-up that recklessness is inviting.

Communications.

Deficiency of Brakes.

Editor National Car and Locomotive Builder:

Your excellent article on "Defects of Brakes" strikes a vulnerable spot in our railroad safety appliances. As you say, the public have been made familiar with the promptness with which trains can be stopped by efficient brake power; but is there not a danger of this knowledge lulling both the railroad officers and the public into a false sense of security? They know the air brake can make wonderfully short stops, they know it is on the train, but they do not know that its efficient action can only be secured by eternal vigilance and care for all the details.

Truly the air brake has demonstrated that with all in good order it can stop a train from a speed of 41.5 miles per hour on a one per cent. down grade in 485 feet, and we know that with a brake power of 80 per cent. of the weight of the train, it can be stopped from a speed of 40 miles per hour in 331 feet; but that presumes, as before, that everything shall be in good order and every wheel braked. There is a great contrast between this fact and the instance you mention of, the vestibuled train which ran 2,000 feet after getting a sudden signal to stop. This is all the more striking because the service of a vestibuled train is especially designed and publicly proclaimed to afford greater speed and safety—these are the inducements offered the public for their patronage, and the exhibition of such total lack of efficiency in its brake power in the hour of danger is calculated to startle any but the most apathetic, and followed as it is by your declaration that it is not an exceptional case, but that you "have the best reasons for knowing that it would be found to be the rule rather than the exception on many roads," ought to awaken the most inveterate of railroad Rip Van Winkles lest these words should rise up in judgment against him. The public might also take alarm and give vestibuled trains a wide berth. But what alternative have the public? Will they not infer that if vestibuled trains upon which every care has been lavished prove so treacherous in the face of danger that their chances of safety under similar circumstances on ordinary trains is very small, and will not the facts bear them out? At this moment of writing the public press contains records of five railroad accidents in which a total of 13 people were killed and 40 injured, and I have seen it stated in railroad journals that not more than a third of the accidents ever come to the surface of the public press. Only a short time ago I met a fellow-passenger, who informed me that he was a claim agent, and was on his way to settle with passengers that had been in an accident on that road the day previous, in which four were killed outright and 23 injured; careful search through the daily papers showed that some of our most prominent journals never got the news at all, or if they did they did not publish it, while others had but a few lines evidently dictated with official care. There is no other country that pretends to our equal grade of civilization in which such sacrifice of life could be "hushed up" and buried without official investigation. In the face of such facts, is it not folly to talk of the "interference" of government with railroad business as soon as the appointment of competent commissioners to make official and impartial investigation is mentioned? Surely there is some one or more persons upon whom rests the moral responsibility for this state of affairs. Cannot the proper machinery be set in motion, that they may be reached? Other countries have officers whose duty it is to investigate railroad accidents and point out defects; the remedy is then sure to follow, and thus, and thus only, can all the painful sacrifice of life be made to result in greater safety to the living. No words ever carried more weight of truth than those of your article, in which you say "what is badly needed is more light on the cause of accidents." The public will not much longer be satisfied with a seeming explanation couched in such sentences as "train parted," "brakes failed to hold," track spread," etc, etc., when investigation may reveal that the accident might have been largely mitigated or altogether avoided had proper vigilance been exercised or care been taken that the ordinary safety appliances were efficient and in good order.

While thus declaring my appreciation of that part of your article which relates to the investigation of accidents and increased car brake efficiency, I must record my conviction that the latter part of the same article, referring to brakes upon engine trucks, is somewhat illogical. You do not approve of them, yet you say the practice of running Pullman cars with six-wheeled trucks with brakes applied to only two pair of wheels "is an outrage upon the traveling public." What, then, shall we say of the practice of running eight-wheeled engines with brakes upon only two pair of the wheels? Then, again, you admit it may some day become necessary to apply brakes to engine trucks, but immediately point out that if brakes were applied to all wheels except engine trucks, then engine truck brakes would be unnecessary.

Since the NATIONAL CAR AND LOCOMOTIVE BUILDER sees the necessity of covering every wheel of a six-wheeled truck with a brake, I do not despair of its complete conversion to the necessity of engine truck brakes. It already admits that "they may be necessary some day." Why not to-day? Suppose every car wheel braked to its utmost capacity, and every engine wheel likewise, with the exception of the engine truck—which, remember, often carries thirty per cent. of the engine weight—and picture yourself in the position of that unfortunate passenger who, a few weeks ago, stood up in the rear end of the night express and saw the engine of section No. 2 coming on to him, would you not pray for a brake on the engine truck? In any case, might it not be the necessary margin between life and death?

The above incident shows in a strong light the wisdom of the Illinois State law that makes it imperative to have an independent steam brake upon the engine; then, if the air brake fails on the train, as it did in this case, the engineer has at least one brake to fall back upon so long as there is steam in his boiler, and when there is no steam no brake is needed.

JAS. HOWARD.

53 BROADWAY, New York.

A Safety Appliance for Car Coupling.

COBOURG, Canada, Nov. 9, 1889.

Editor National Car and Locomotive Builder:

I take the liberty of writing you in regard to an idea which I have thought over a good deal.

It is about freight car couplers. I see a great many accidents in the papers where men are injured in coupling cars, and I have no doubt a large proportion of them are caused by the men slipping or falling down when they are making the coupling, which I think could be avoided.

My idea is to place on the end of the car an iron strap on each side, turned out to a square corner at the bottom, with a side handle above it on the end of the car, so that the man who couples the cars would stand on the footstep when in the act of coupling and catch hold of the handle with his other hand. In this case he would not slip or fall when making the coupling, no matter if the cars were moving or not, which I think would overcome the danger of it to a very great extent, especially at night time. I would make the footstep of, say, 2-inch × 1-inch iron, and let it project only far enough to contain only one foot at a time, so that there would not be any chance of tramps etc., stealing rides on it.

However, I send you the above as a suggestion, and you can make what use of it you like. My object in doing so is that it may save many a poor fellow from being maimed for life or worse.

The above could be applied on all freight cars, and it would not be so costly to the railway companies as changing to new self-couplers, and it might be adopted by railways which would not go to the expense of self-couplers.

HERBERT BOGGS.

MICHIGAN CENTRAL RAILROAD COMPANY.
DIVISION SUPERINTENDENT'S OFFICE,
ST. THOMAS, ONT., NOV. 6th, 1889.

Editor National Car and Locomotive Builder:

In your November issue an article appears, Defects of Brakes. A portion of it nearly at the last end reads as follows: "Simple means might be devised to compensate for the wear without permitting brake to become inoperative, or the gauge that shows the travel of the piston might be brought into more general use."

I take pleasure in enclosing to you printed form and cut of an automatic air brake register, the device of and patented by Mr. Robt. Potts, master car foreman of this company, and which is being put on all our cars. Also in connection with this rules governing the use of same. If you can make any use of them you are welcome to them.

You are the first that I have noticed taking up this question, and I am only too glad to give you what information I can relative thereto. With this device under each coach, it is not expensive and there will be no trouble with the piston in the brake cylinder at the end of its travel.

As chairman of the Committee on Roadway of the North American Association of Railroad Superintendents, I will take pleasure in bringing this to their notice at the next meeting.

J. B. MORFORD, Div. Supt.

[Annexed is the circular referred to by Mr. Morford. The Potts air cylinder gauge mentioned was illustrated in the May number of the NATIONAL CAR AND LOCOMOTIVE BUILDER. It is a very simple and efficient device, and ought to be an attachment of all air-brake cylinders. It cannot cost more than a few dollars, and we can see no reason why it should not be generally adopted by railroad companies.—ED. N. C. AND LOCO. BUILDER.]

ST. THOMAS, Oct. 29, 1889.

To Car Inspectors and Repairers:

You will notice that air brake registering gauges are being applied to all passenger cars equipped with air brakes, to ascertain the exact condition of travel of piston in air cylinder. When register block shows 12 inches travel on the figured bar, this is proof that no more brakeing power can be obtained, and whenever this occurs it will be your duty to shorten the lower brake rod on the Stevens system of brake leverage to two full turns of swivel, which will make four inches on the travel of cylinder pistons. This can be continued on the lower rod until the rod can be shortened one hole. On what is known as the Hodge system, same as is used on sleeping cars, the slack can be taken up on the top end of what is known as the dead lever, until such times as a distance can be taken up between holes on lower or top rod, as may be required. Great care must be exercised not to take up more than two full turns on lower truck rods, or more than the distance of one hole on dead lever of each truck.

When this is done, push sliding block on figured bar forward to about figure 6, so that it can begin registering again. Do not use a hammer to push sliding block forward on bar, but move it by hand.

The ordering of the new equipment for the extension of the New York, Ontario & Western has been postponed till the beginning of the year.

Mr. Martin J. Higgins, superintendent of the Milwaukee & Whitefish Bay Railroad, was found dead in his sleeping berth on board a train at Dwight, Ill., Nov. 7. Mr. Higgins had been in railway work for a number of years, and was formerly superintendent of the Northern Division of the Wisconsin Central.

The reports from all the important lumber distributing points are to the effect that business is being seriously inconvenienced by the scarcity of cars, and although several railroads have placed orders for new cars, which are being delivered as fast as the capacity of the different car works will permit, the demand seems to increase daily. Car works all over the country are filled with orders and have not been so busy for years. This is certainly a hopeful business indication, extensive transportation being a reliable barometer, indicating activity in all departments of trade. The Fort Wayne car works are turning out 50 cars each week; the Pullman Car Company is surfeited with orders; the Terre Haute and the Indianapolis car works are both crowded to their fullest capacity, and fail to meet the demand of the railroads which are unable to move the freight offered through lack of transportation facilities. All branches of business are suffering on this account, but none more so than the lumber trade.

Best Filling in Painting Driving Wheels.

At the last convention of the Master Car-Painters the following paper was read by Mr. John G. Keil, Chicago & Alton:

Take a set of engine driving wheels (six wheels to a set) and if very rusty and full of scales begin on all flat parts with a flat steel wire brush and remove all scale and rust. As the brush cannot be used on the spokes and other round parts, take a file and have the end flattened and sharpened to a sharp, smooth, square edge, and with this file remove all rust and scale. This part of the work can be done by a laborer and will take from seven to ten hours. As this is a very important part of engine painting (namely, getting off all rust or scale) I would suggest that all master painters should see that their help be properly instructed as to the results of leaving any scale or rust on wheels, domes or tanks. Some of the results of wheels not properly cleaned are first a jimboles of rust showing through the varnish. After a few months of wear these specks of rust unite and cause flaking off. Although all rust does not begin before the painter starts his job, he is held responsible if his engine shows up bad after a few months of service. Therefore, gentlemen, it is very important for us to find out what constitutes the best filling and what will wear the longest on iron and steel. In my opinion, any mineral oxide will fill the grain or pores of the iron better than any other pigment or material in the market.

For priming take 6 pounds dry mineral, 1½ pints of raw oil, 3½ pints of turpentine, ½ pint japan. This priming dries quite flat and is dry enough for second coat next day, or in extreme cases of hurry it can be puttied next morning. Perhaps some member at this point may say, "Why use dry mineral or why not use dry white lead or keg lead?" My first reason for not using lead is because it is of a corrosive nature; second, because the present method of rotting the lead with chemicals leaves it more susceptible to rust iron or steel. At this point I advance the same theory as the house painter in flatting walls with lead. If he first puts on a coat of thin glue size the lead does not come in contact with the chemicals or alkalies in the plaster. If he does not put on a size his coloring is burned out in a short time.

I therefore think that lead on iron and steel will increase the rusting instead of being a protection to the iron.

Again, "Why use raw oil instead of boiled oil?" My reason for using it is that it dries all the way through, and dries harder. Boiled oil is more liable to skim over, and in my opinion raw oil has better wearing qualities.

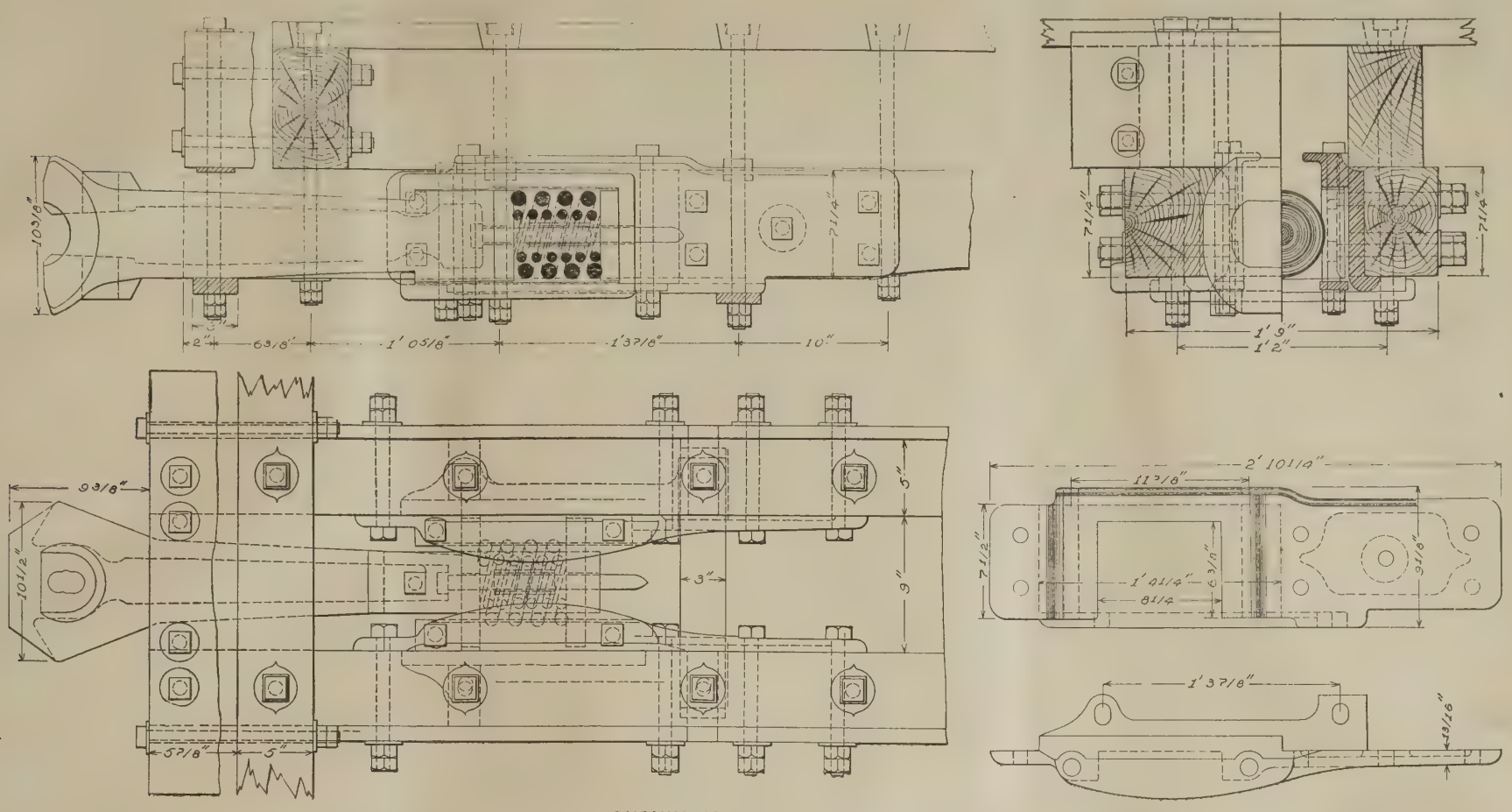
Raw oil must be used with greater care than boiled oil, for in case of an overdose of japan it will cause delay in drying, as more japan than is necessary will retard its drying.

For second coat I use the same formula as for priming, except add about one pound of dry mineral, and then to suit with turpentine.

After the second coat is thoroughly hard I take the following mixture: One gallon rubbing varnish, one quart of japan, one pint of turpentine, and make a stiff, hard putty of half-dry mineral and dry white lead. This putty must be well pounded, taking from four to six hours. After puttying all large holes I glaze all uneven parts. Next day I thin this putty down to about the consistency of rough stuff. Next day this coat will sandpaper down quite smooth and leaves a good surface ready for first coat of flat drop black. If the job is not quite as smooth as desired, I give one coat flat and two coats varnish drop black, and finish with one coat locomotive rubbing varnish and one finishing varnish. The time consumed in doing a set of six wheels in this way is about 25 hours, or at a cost of about $6. The total time consumed is about eight or nine days. Although the work can be done in this short space of time and in general will wear well, I do not recommend or approve of this way of doing work. Still, where a master painter is asked to get his engine out in the shortest time possible, I think this method is both economical and durable, considering the time consumed. Also when the superintendent of motive power or master mechanic says get the engine out three or four days earlier, and it will earn enough in that time to pay for painting and meet the demand of the company in giving transportation.

Since you have assigned this subject to me I have taken a great deal of interest in finding out just how these jobs wear. I will give the record of several engines as they appear on my record book: Engine 145, painted May, 1887, finished in nine days, was out 26 months and cleaned up and is still in good condition; engine 29, painted November, 1887, is still "O K;" engine 104, painted October, 1887; engine 87, out 14 months. All of these jobs show a good record, especially against rusting.

I have given you the best filling that has come under my notice, and if any member in this convention is dissatisfied with his present method, I ask him to give it a fair trial and test its merits.



CUSHING'S DRAW-BAR STOP.

The annexed engraving illustrates a useful improvement in drawbar stops, invented by Mr. G. W. Cushing, superintendent of motive power of the Union Pacific. When Mr. Cushing went to Omaha the company was using old-fashioned, defective stops, the front and back stops being cast separately. They were weak attachments, that took a very small amount of hard usage before becoming loose. Being tied to a small portion of the timber, the blows communicated to the stops very often caused the splitting of the draw timbers. The drawbar stop illustrated was designed by Mr. Cushing to remedy the evils and defects mentioned. It will be noticed that the front and back stops are cast in one piece, and that the stop is gained into the draw timbers. This arrangement provides the means of tying the whole draw stop into a particularly strong combination, which is impervious to the severe butting or pulling shocks of yard and train service. The stop attachments cover a large surface of the draw timbers, and are re-enforced by a wrought-iron brace which ties the draw timbers and stops together, making the parts assist each other in resisting shocks. The Union Pacific Railway Company already find that this improved stop is materially reducing the expense of freight car repairs.

Dangers of Defective Hearing.

When the fact became generally known a few years ago that color blindness was not an uncommon defect of vision, a certain class of quasi scientists worked up a furore of excitement about the danger that the traveling public were subject to from the presence of color blindness among railroad employés. As soon as they understood that there might be mistakes made in signals by trainmen or others suffering from color blindness, most railroad managers displayed a readiness to subject their men to common sense tests, which would show if there was anything the matter with the vision of employés who had anything to do with signals. The form of test that naturally suggested itself to practical men was, to use the flags or lights which the men interested would be called upon to distinguish, but this was too simple a form of test for the quasi scientists, and they insisted with noisy clamor that none but trained oculists were able to determine whether or not an engineer or conductor was capable of telling the difference between white and red. These people were so persistent and presuming in their claims that in numerous cases cheek and mendacity triumphed over reason, and many railroad companies or their employés are to-day paying a tax to oculists for examinations of vision that might be just as satisfactorily performed by the officers who conduct other examinations.

In spite of labored efforts to keep up the excitement about the dangers of color blindness and the necessity for employing expert examiners, it has entirely subsided, and the tendency is growing to permit the officers who examine men on their general fitness for employment to ascertain if they can distinguish signal colors. But now railroad men are threatened with an agitation worked up for the purpose of fondling a new reputed source of danger due to railroad men suffering from organic defects. This time it is deafness. The special apostle of this source of danger is a Dr. Robert Barclay, of St. Louis, who holds the position of consulting aural surgeon of the Missouri Pacific and other roads that might be considered among the last to interest themselves in non-essential requirements of good railroad men. But, as often happens, those that are very careless about requiring characteristics which ought to be essential, display the greatest solicitude about matters that common sense says are of no consequence. This consulting aural surgeon of the Missouri Pacific, in a recently published paper, makes an earnest plea to other railroad surgeons and railroad officers on the dangers liable to result from railroad employés having defective hearing. He mentions cases where the ears of engineers were injured by the incessant whistling caused by the valves of locomotive whistles getting out of order. Accidents of this kind are, no doubt, much to be regretted, but our sympathies are not so much with the engineers as with the long-suffering public who had to endure the noise. In fact, certain parts of the public would hear with grim satisfaction that there was danger of incessent whistling injuring the aural attachment of every engineer who indulges in unnecessary noise making. They would regard it as a case of natural retribution. Perhaps the Missouri Pacific officials think it is all right to employ engineers who do not know enough to stop the noise of a whistle when the valve sticks open; but most railroad companies would think it was necessary to add a little more punishment than that given by the noise to a man so deficient in resources as to let the whistle scream until the steam was exhausted.

But it was not alone among engineers of limited natural resources that the consulting aural surgeon found men of defective hearing. There were discovered quite a number of trainmen and others whose auditory faculties were not in a satisfactory condition, and the hearing of the shop men was by no means what it ought to be. This part of the case is, we admit, very serious, and explains to us certain obliquities of disposition displayed by shop men. It had not occurred to us that a boilermaker's ear not having an accurate measure of the sound produced by the blow of a riveting hammer, might be the reason why these artisans sometimes give unmerciful whacking to the sheets of a a tender fire-box, but the paper of the consulting aural surgeon offers a charitable explanation. We have repeatedly known of machinists, who were directed to examine the piston packing of engines, soldier round and mark the nuts of the heads with wrenches to make it appear that the work was done when the heads had not been taken off, and we were disposed to entertain wrathful feelings toward such men, but the thing may have happened through their aural attachments being out of order. Many other shortcomings of shop hands, that send out engines and cars in an unsafe condition, must be due to the disorders of their aural organs, if defects of hearing of such railroad employés is a public danger, as Dr. Ramsay insists that it is. As a crowning illustration of the danger that may result from defective hearing, the consulting aural surgeon of the Missouri Pacific mentions the following case, and attributes the overlook of the engineer and fireman to defective hearing, as otherwise they must have heard that the rest of the train was not there: "Thursday evening the 8:20 train, which brings passengers leaving Paris at 5:30, entered the station of Provins, where it was awaited as usual by about fifty people. The chief of the station, the employés and others who were about opened their eyes in astonishment. The engineman and fireman alone continued their progress with the tranquility which comes from the sense of a duty done. It was only when the locomotive had stopped that they began to see and understand the astonishment of the spectators. The locomotive, the tender and a baggage car alone had come from Longueville. In making up, the employés had simply forgotten to couple the rest of the train."

The drift of the alarm raised by the consulting aural surgeon of the Missouri Pacific goes to make out that the painter who exerts his skill in embellishing the inside of a passenger car, or his humbler associate who exerts his muscle in preserving the wood-work of a freight car by smearing it over with a coating of iron paint, cannot do his work properly unless his aural organs maintain harmony of touch by making the hand follow the responsive sound of the brush; that the carpenter's chisel and adze can only perform work worthy of the high-souled, conscientious workman, when the cutting sound is in perfect unison with the teaching of the eye and the subtle touch of the hand. The machinist and the boilermaker and the blacksmith have all their harmonies of execution that cannot be perfect where aural disorders exist. When this latest philosophy of safety, efficiency and utility shall have been fairly developed, it will be in order for railroad managers to get in working order a bureau of high-paid auralists to test the hearing of their employés at all ranges.

The new railroad shops of the Long Island Railroad, at Morris Park, have been completed. The last piece of machinery was put in place and work in the shop was begun. One hundred and forty men are employed in the shops. The old repair shop in Long Island City will be abandoned.

An English inventor has succeeded in making flexible metallic tubing that ought to have great practical usefulness. The tubes are made from continuous strips of metal pressed into a section something like the letter S, and this continuous strip is coiled upon itself in such a way that the parts of its section interlock. The tubes are said to be perfectly tight for air and steam with moderate pressures. It looks as if this would be a good material for the pipe connections between cars heated by steam.

Early in November Texas and New Mexico had the very unusual experience of a severe snowstorm, which blocked many railroad tracks, froze to death great numbers of sheep and cattle, and inflicted severe distress upon the people of the districts affected. The railroads in that region are not prepared for snow blockades at any time of the year, and they were badly situated for overcoming the obstruction to travel. The Denver, Texas & Fort Worth suffered most severely, and their main line was blocked till a rotary snow plow was borrowed from the Colorado Midland. When that machine was received it very quickly opened the track. But so much delay occurred in getting the rotary to the scenes of the blockade that no through train was run from the South to Denver for eight days. Some towns were getting very short of food supplies before the line was opened, and as it was hundreds of people were put to great inconvenience. The fall of the snow is said to have averaged three feet on the level, and the fierce wind filled many of the railroad cuttings entirely.

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EDITORIAL ANNOUNCEMENTS.

Advertisements.—*Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING COLUMNS. *The editorial department will contain our own views and opinions; and the rest of the reading matter, aside from advertisements, will be such as we consider of interest to our readers.*

Contributions.—*Articles relating to railway rolling stock construction and management, and kindred topics, by those who are practically acquainted with these subjects, are especially desired. Also early notices of changes in railroad officers, organizations and names of companies.*

Special Notice.—*As the* CAR AND LOCOMOTIVE BUILDER *is printed and ready for mailing on the last day of the month, advertisements, correspondence, etc., intended for insertion, must be received not later than the 25th day of each month.*

To Subscribers.—*We occasionally receive complaints from subscribers that their paper is not received regularly. When cause for such a complaint exists, the blame lies with the mails or with the method of delivery, for the paper is mailed regularly to every subscriber each month without mistake. Any subscriber who fails to receive his paper ought at once to notify the postmaster at the office of delivery. When a subscriber changes his address he ought to notify this office at once, so that the paper may be sent to the proper destination.*

Counterbalancing Locomotives.

It is difficult for any one to remember the time when there was not some controversy going on in the United States about what means can best be employed for balancing the mechanism used in transmitting the power of locomotives. Locomotives on American railroads have always been run with smaller driving wheels than those used on railway motive power in other countries, and the great piston speed required at high train velocities leads to an aggregation of disturbing forces which constantly directs attention to the defects and inequalities of ordinary counterbalancing. When a wheel running on a rail is perfectly balanced, its tendency is to maintain nearly uniform motion and to impart to the rail an even, unvaried pressure equivalent to the weight of the wheel plus its load. If power could be applied to the driving wheel of a locomotive in the same way in which it is transmitted to the driving pulley of shafting and through electrical driving mechanism, there would be no counterbalancing necessary and no disturbing forces to control. But the system of transmitting power from the cylinders through a crank puts extra weight on one side of the driving wheel, which effects a most disturbing action upon the engine unless neutralized in some manner.

The disturbing action of the crank and its connections upon the locomotive attracted attention early in the railway era, and the subject was thoroughly investigated by many of the ablest engineers who have ever interested themselves in locomotive operating. Experiments to determine the extent and the effect of unbalanced parts in locomotive machinery were begun over fifty years ago, and as early as 1837 counterbalance weights were employed to neutralize the disturbing action of the crank and its appendages. English, French, German and American engineers vied with each other, for the first twenty years after the "Rocket" demonstrated the practicability of high speed, in identifying and measuring the various internal disturbing forces caused by the inertia of the locomotive mechanism. M. Le Chatelier, the famous French engineer, whose name is familiar to us in connection with the water brake, took a special interest in this subject, and devoted to it much scientific research. In 1849 he published in Paris "*Etudes sur la Stabilité des Machines, Locomotives en Mouvement,*" which contained the results of the investigations of the author on the stability of locomotives, and embraced all that had been previously ascertained on the subject by other engineers. That work was the most thorough exposition of the subject ever published, and has supplied material to a great portion of the writers on counterbalancing of locomotives up to the present time. Rules for the counbalancing of locomotives were given, which, with slight modifications, have been followed by all the engineering world. They are the rules given by Clark in his "Railway Machinery." That author, in treating on the effect ofinertia of the mechanism as shown in Le Chatelier's work, says:

"A locomotive in motion may be affected by angular or pendulous movements, horizontally and vertically, and by a longitudinal fore and aft movement, coinciding in their oscillations with, and arising from, the internal reciprocations of the mechanism. The pendulous movements are of three kinds, and take place round the horizontal and vertical axes of the machine, passing through its center of gravity, or nearly so: 1st, horizontal vibrations round the imaginary axis of motion, giving rise to a sinuous or serpentine motion, right and left; 2d, vertical vibration on the axis, a pitching and plunging motion; 3d, vertical vibration on the axis, or rocking or rolling motion laterally; 4th, a longitudinal reciprocating or fore and aft movement, rectilineal and parallel to the rails. These erratic movements, though originating in the mechanism, are materially affected by the general arrangements of the machine, as to the disposition of weights, placing of axles, design of springs and so forth."

The action of the centrifugal forces developed in the revolving driving wheels are thus described:

"When the diameter of the wheel and the speed on the rails are the same, the central force increases directly with the length of crank or with the length of stroke; it also increases directly with the weight of the revolving masses of the crank and the connecting rod."

"When the diameter of wheel and other matters are the same, the centrifugal force of the crank and connecting rod increases as the square of the speed on the rails; that is, for twice the speed there is four times the disturbing force."

"When the speed on the rails and other matters are the same, the centrifugal force of crank and connecting rod increases, as the square of the diameter of the wheel, inversely; that is, for half the diameter, with the same speed, the disturbance is not merely doubled, but increased four times; on the contrary, with double the wheel there is only one-fourth of the disturbing force."

"These conclusions show not only the great influence of speed in increasing centrifugal force, but also the equally great influence of the diameter of wheel in reducing it, so that if the diameter of wheel be increased in proportion with the speed, other matters being the same, the centrifugal force of the crank and connecting rod would remain unaltered. They explain also the great increase of disturbance from unbalanced masses arising from a relatively small reduction of the wheel; for example, a reduction of the wheel from 6 feet to 4½ feet, or in the ratio of 4 to 3, would increase the disturbing force at the same speed in the ratio of as 3^2 to 4^2 or as 9 to 16, nearly double.

"The centrifugal force of the crank and connecting rod is of more consequence to the stability of the locomotive by its horizontal action parallel to the rail than by its vertical action."

The early European engineers held that the vertical action of the unbalanced mechanism was of little consequence, as it was successfully resisted on one side by the rails and on the other by the weight of the engine. Their efforts were therefore directed to neutralizing the fore and aft action of the reciprocating and revolving parts to prevent the locomotive from jerking while in motion. To do this successfully, it became the practice to put counterbalance weights opposite the cranks equal to the weight of the crank and of the reciprocating parts. With their practice of increasing the diameter of the driving wheels so that the peripheral speed on the rails would be no greater than the speed of the smaller wheels used for moderate speed, the vertical force of the counterbalance weights was not an element of danger.

When, however, the formulas of European engineers were adopted by American locomotive builders, and immensely heavy reciprocating parts were completely balanced in extremely small wheels running on light rails and over light bridges, a serious element of danger was introduced. The counterbalance weight, when stopped in its downward path, imparts a blow to the rail with a force equal to the momemtum of the unbalanced weight. There is no doubt but this "hammer blow" has broken many rails and occasionally caused the failure of bridges.

All sorts of contrivances have been invented to remedy the disturbing results of unbalanced mechanism. As early as 1841 Bodmer, an English inventor, with a view of getting an improved balance, patented a locomotive to have two cylinders on each side, with the pistons working in opposite directions. In 1861 Haswell, of the Austrian state railways, built a locomotive with two cylinders on each side, and in our own generation we have the Shaw locomotive of the same kind. These engines are too complicated for general use, and it is not likely that the engineering world will ever go so far looking for a remedy for unbalanced mechanism. A simpler form of attaching reciprocating parts to the frame equal in weight with the piston and its appendages, and operating in the opposite direction to the piston, has been tried and abandoned. The recent proposal to set the cranks opposite each other is not new, nor is it likely to meet with much favor.

We have known of several cases lately where locomotives bent the rails badly over miles of track. It is needless to say that the engines were very heavily counterbalanced, that they had small wheels, and that they were run at very high speed. When a thing of that kind happens it is hardly necessary to suggest the danger of running the same engine over a rigidly frozen track on light rails.

It is practically impossible to obtain a perfect balance while transforming rectilinear to rotary motion, and in trying to decide on an approximation to perfect balancing care should be taken to keep the vertical action as light as possible. Because the vertical action is not apparent in the ordinary trials of a locomotive, it has generally been treated as though it did not exist. The great majority of American locomotives are too heavily counterbalanced. If an engine runs smoother with the steam shut off than when it is on, the counterbalance is too heavy. A rule for counterbalancing which makes a smooth-running engine, and makes the minimum vertical blow consistent with controlling the horizontal inertia, is followed by several of our builders and master mechanics. They take half the weight of the main rod, all the weight of cross head and piston, and deduct one-fifth of the sum for friction and compression. Half of this weight is put on the main driver, and the remainder divided among the others. This is the best that can be done. The true remedy, however, for the evil results of the hammer blow is to make the driving wheels larger. A great many locomotives have the driving wheels specified senselessly and dangerously small. An engine with very small wheels is extravagantly expensive on repairs, and if run at high speed her wheels act like battering rams on track and bridges.

Carelessness in Selecting Trainmen.

In our last issue a correspondent directed attention to the prevailing carelessness respecting the attainments and character of the men appointed to fill the positions in train service from which the men are drawn who exert the greatest influence on the operating expenses. Of late strenuous efforts have been making to induce trainmen to practice the most economical methods of using supplies; but in many instances the instructions and injunctions of the higher officers have produced no good results, principally because many of the men interested are wedded to and prejudiced in favor of wasteful practices that have originated in ignorance and become common through carelessness and the desire to do work with the least possible amount of personal exertion. With men handling railway machinery, who are densely ignorant of the laws of nature controlling mechanical operations, no radical improvement can be expected. An intelligent man will generally perceive the defects of a vicious system when it is pointed out, and he will generally adopt a new practice when directed to do so, but the ignorant man has a limited mental vision which leads him to hate any change, so he will cling tenaciously to the practices he is familiar with, and resent the injunctions to follow improved methods as the emanations of superior knowledge with which he has no sympathy.

It has been demonstrated to the satisfaction of all reasonable persons that ignorant labor is expensive labor, but the obvious lesson of this truth has been too often neglected by the men responsible for hiring railroad employés, and it is doubtful if any improvement in the character of new men has taken place of late years. The higher officers appear generally to realize that intelligence has a high money value, and they are quite ready to proclaim their belief from the house tops, but their precepts, in too many instances, exercise no influence on those who do the work of hiring men. We have been very much disappointed of late to find from personal contact that new men, engaged in departments where the heads were very positive in their expressions in favor of improving the personnel of railway service, were of a very low average in intelligence and in morals. The explanation of this has been that it was necessary for the head of the department to depute the engaging of new men to subordinates, and that when these persons were instructed to engage none but intelligent and worthy young employés the whole duty of the higher officer had been performed. We do not think that the full duty is performed in this matter so long as it is possible for a foreman and trainmaster to stock the road with unworthy material. It is as much the duty of a superintendent or master mechanic to make himself familiar with the character of the men entering the service, as it is for him to see that material for mechanical purposes is of the quality that has been paid for. The head of a department or division cannot always attend to the details of selecting men; but if he will make it his business to see and converse at some time with all the men who are engaged for service that will lead them to positions of trust or responsibility, it would put an effectual check upon the practice of engaging men utterly unfit for higher duties than that of common laborer.

Resurrecting Obsolete Mechanical Forms.

A man familiar with the history of industrial development and intimately informed on inventions finds it very amusing, month after month to watch the pages of the United States Patent Office Record and note the numerous patents that are monthly granted for old devices that have been found impracticable. So far as railway machinery is concerned, we have seldom seen an attempt to revive a stronger combination of impracticable arrangements than what was lately done in the patenting of a locomotive to have the drivers arranged in flexible trucks and to be driven by vertical cylinders drawing steam from an upright boiler. All the elements of this combination are old and all have proved of no account.

About the time that the advantages of the American invention of a flexible truck for carrying one end of railroad vehicles began to be recognized in Europe, some engineer

conceived the idea of applying the principle to the driving wheels of locomotives. The outcome was the Fairlie type of locomotive, which has the driving wheels secured in one or more trucks that are free to curve on an alignment different from that maintained by the frame that supports the boiler. Great hopes were entertained of this arrangement materially reducing the friction of the engine in rounding curves, and a great variety of locomotives have been constructed on what has become known as the Fairlie principle. The Mason Machine Works, of Taunton, built a considerable number of locomotives of the Fairlie type, but they never became popular in the United States, for it was found that while they curved no better than ordinary locomotives with short wheel base, they were decidedly more expensive to maintain in running order. Although there are not now many of that type of engine to be found in this country, railroad mechanical men are perfectly familiar with its merits and shortcomings.

The Hedley locomotive and those built by George Stephenson for the Stockton & Darlington Railway had vertical cylinders, and the same plan was adopted repeatedly by early American locomotive designers. The Baltimore & Ohio Railroad Company had many locomotives in use with vertical cylinders, and some of them are to be seen doing switching service to-day. At this late day it is hardly worth the time to discuss the disadvantages of using vertical cylinders on locomotives. The man who is not familiar with the disturbing forces generated by transmitting the cylinder power from above the horizontal level of the axles is not competent to give advice respecting the designing of locomotives. Yet such badly-informed persons, if they have sufficient assurance and persistency, get capitalists to back them in putting the conceptions of ignorance and products of folly into machines that are urged upon practical men as improvements on the best forms of engines.

Increase of Steam Pressure in Europe.

There is a decided tendency in Europe towards higher boiler pressure for locomotives than anything yet employed on this side of the Atlantic. Where increase of tractive power is demanded, the prevailing tendency is to keep the cylinders about the same size as the old standards, increase the strength of the connections and provide a boiler that will supply steam of about 200 pounds per square inch.

The advocates and builders of compound locomotives have taken the lead in the introduction of higher boiler pressures, and many locomotive engineers who have no confidence or belief in the principle of compounding are quietly following the lead toward high pressure of steam. Many locomotive superintendents are by no means backward in expressing their opinion that any advantage in economy gained by the compound locomotive over simple engines is due to the higher steam pressure habitually employed by the former. Mr. Dougal Drummond, locomotive superintendent of the Caledonian Railway, has repeatedly challenged the advocates of compound locomotives to put engines in competition with the simple engines he uses in operating the passenger service of the company's main line between Carlisle and Aberdeen, and thus far there has been no inclination manifested to accept the challenge. Mr. Drummond has carried out a carefully conducted series of experiments to demonstrate the economical value of high pressure steam in simple locomotives and he is perfectly satisfied with the result. The standard pressure for his passenger locomotives has for several years been 150 pounds per square inch. He has for some time been building engines with boilers safe for carrying 200 pounds to the square inch, and now proposes making that the standard pressure. He took six engines and worked them for a time on the same train service, and made careful records of the performance. Two of the engines used steam of 150 pounds pressure, two of 175 pounds and two of 200 pounds pressure. The run from Carlisle to Aberdeen is 249 miles, and the engine that starts with a through passenger train takes it the entire distance and is run all the way by one man. The trains are generally about the same weight, so the service provided the very best kind of work for competitive trials. A hydraulic dynamometer was used to record the pull on the drawbar, and indicator diagrams were taken from the engine cylinders at regular intervals.

The writer was accorded the privilege of riding on these locomotives, and he found them to be particularly efficient engines for hauling high-speed trains over an indulating road. The engines weigh about 40 tons each, and have inside cylinders 18 × 26 inches, transmitting power to two pairs of coupled driving wheels about 7 feet diameter. The engines not only keep up a uniform speed with ease on grades of one per cent. and over, but start the train from stations with remarkable quickness. The heaviest train we saw had eighteen carriages, most of them with six wheels, the whole probably aggregating 200 tons. The running speed varies from 45 to 60 miles an hour. The method of operating trains is such that it is common to run for two hours without any break in the speed. The whole length of the main line is worked on the absolute block system, and, guided by the signals, the driver has no hesitation in rushing at full speed through crowded towns, passing at the same time over a complication of sidings. Although such places are approached by sharp curves through deep cuttings in the darkness of midnight, there is no hesitation or fear that the track will not be perfectly clear. All that is looked for are the signals which guard the main line. If these are clear the line is certain to be safe. The block system is somewhat expensive to maintain, but it is the only safe way to handle heavy traffic. There is no question either that it pays. It saves the expense incurred by frequent accidents, and provides for the rapid and prompt handling of trains. No one interested in American railroad matters can watch train operating in in Britain without wishing that our managers would display more willingness to imitate the best practices in vogue there.

Report of the Proceedings of the Master Car Builders' Association.

We have received the report of the proceedings of the twenty-third annual convention of the Master Car Builders' Association. Although our readers are familiar with the contents of this volume through the extended reports of the convention that have appeared in our columns, the full report will be found of great value, for reports and discussions are complete. The reports in the volume are on journal box lid, journal lubrication, car heating and lighting, wheel specifications and guarantee, axle for 60,000-pound car, buffers and carrier irons, brake gear. The latter report with the illustrations is particularly valuable.

The decisions of the cases submitted for arbitration are given and form very interesting reading. Particulars of the decisions of the various letter ballots are also to be found in the report. The volume consists of 252 pages of the usual size, besides a great many folders in the end with illustrations of the text. There is a good comprehensive index. We note that Secretary Cloud has introduced an innovation by putting the reports in small type and the discussions in large type. We consider this an improvement. The report is very carefully prepared and reflects great credit on Mr. Cloud. It has been got out very promptly, seeing that the results of the letter ballots were not known till the beginning of October.

Mr. William Voss, whose articles on Railway Car Construction have attracted so much attention, is now preparing the portion relating to passenger cars, and the articles thereon will appear during the coming year.

When the Committee on Driver Brakes was last year appointed by the Master Mechanics' Association, it was the intention of the chairman, Mr. Charles Blackwell, to investigate as thoroughly as possible the best form and best material for brake shoes. Circumstances prevented the chairman of the committee from devoting the time necessary to carry out the projected tests, and the report, although an excellent one, was not so full or conclusive as had been intended. The subject is of very great importance, and we are gratified to learn that Mr. G. W. Rhodes, who is chairman of the committee appointed by the Master Car Builders' Association to investigate the subject of "Metal for Brake Shoes," is proceeding with his usual vigor and thoroughness to make exhaustive tests to find out what is the best material for brake shoes. He has invited the co-operation of the other members of the committee, and a meeting has been called for the purpose of advising on the kinds of material to be tried and the methods of tests to be followed.

An impression has lately been growing among railroad officers and others that locomotives can be designed so that the recognized forms of spark arresters will not be necessary. In public meetings during the last two or three years, the opinion has been repeatedly expressed that with large grates, good brick arches or their equivalent, and large boilers that will make steam freely while using large nozzles, the sparks will be left in the fire-box where they belong and that no special appliances for catching them will be required. Improved proportions have no doubt done much to restrain the passage of particles of burning coal through the flues, and more will yet be accomplished when enginemen and others come properly to recognize that a sharp exhaust is a detriment instead of an advantage to the free working of a locomotive. But we are under the impression that those who anticipate the dispensing entirely with spark arresters are a little too sanguine.

The writer was recently accorded the privilege of riding on the locomotives of several British railways, and he lost no opportunity of watching the extent of spark throwing. Many of the locomotives had the exhaust so soft that its sound could scarcely be distinguished when the engine was running on the level, and at these times there was no spark throwing. But in ascending grades or in working the train with speed, when the engine had to exert much power, the spark throwing was so decided that the engine could not be run safely in this dry country. There are no spark arresters used on British engines, and they raise but few fires, because the country is nearly always so green or wet that nothing short of a shovelful of incandescent coal will start a blaze. If the men in charge of British railway machinery had as dry a country to deal with as is generally found in America, they would have to apply some kind of spark arrester to their engines.

Personal.

Mr. A. A. Beaver, master mechanic of the Albemarle & Pantego, has resigned.

Mr. Thomas Saunders has resigned as superintendent of the Colorado Midland road.

It is reported that Mr. W. H. Fenner, President of the Allen Paper Car Wheel Co., has resigned.

Mr. S. C. Brooks, one of the oldest master mechanics of the Lake Shore Railway, died at Cleveland recently.

J. E. Ralph has been appointed superintendent of the Atlantic Highlands division of the Central of New Jersey.

Mr. Charles H. Rockwell has been appointed general superintendent of the Columbus, Hocking Valley & Toledo Railway.

A. A. Allen, general manager of the Chicago & Great Western, announces that Mr. John T. McBride is appointed superintendent.

Mr. K. Colbran has been promoted to the position of general manager of the Colorado Midland, with headquarters at Colorado Springs.

Mr. Hunter Gunnell, who for some years past, has been purchasing agent of the Ohio, Indiana & Western road, has tendered his resignation.

It is reported that Mr. George B. Hazelhurst has been appointed acting general superintendent of motive power of the Baltimore & Ohio.

Mr. Alex. Wallace, president of the Jacksonville, Mayport & Pablo Beach Railway Company, died at Jacksonville, Fla., Nov. 10, aged 57 years.

Mr. W. B. Scott, formerly superintendent of telegraph, has been appointed division superintendent of the St. Paul & Kansas City, to succeed Mr. G. C. McMichael.

J. McGuire, formerly trainmaster for the Chicago, St. Paul & Kansas City, has been appointed division superintendent of the main line from Minneapolis to Elma.

Mr. E. Buckingham, car accountant of the Union Pacific, has been promoted to be superintendent of car service of the entire system, including the proprietory lines.

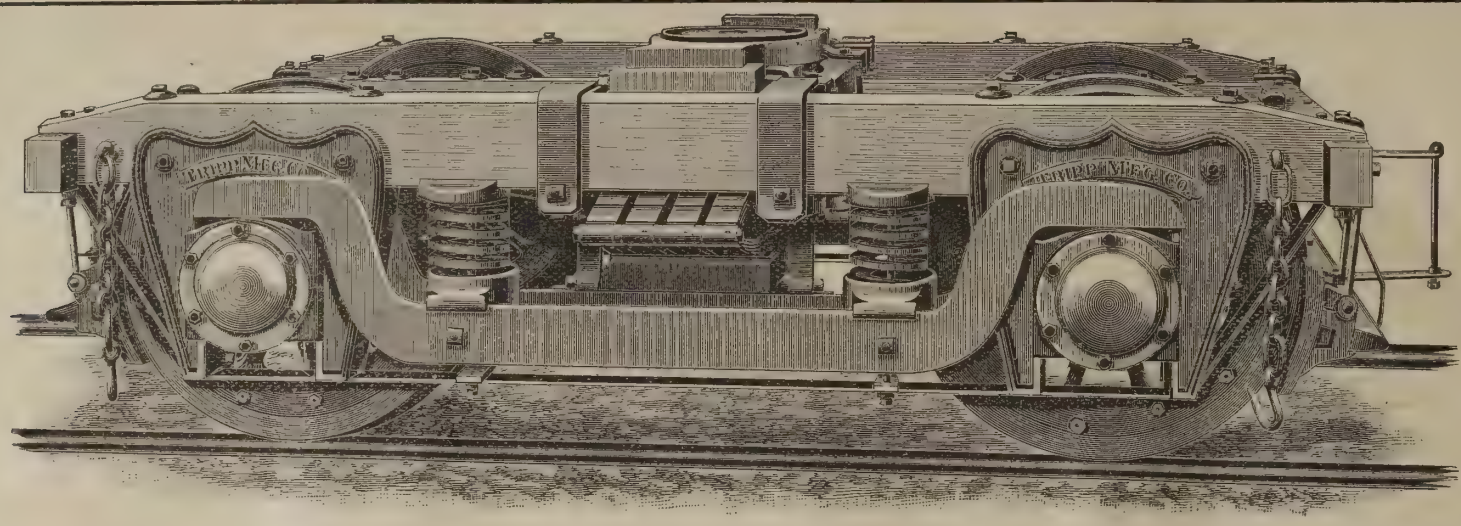
Mr. M. B. Cutter has resigned as superintendent of the Huntington Division of the Chesapeake & Ohio, to accept a position on the Wisconsin Central as division superintendent.

Mr. G. W. Stevens has resigned as superintendent of the easteen division of the Wabash road, with headquarters at Peru, Ind., to accept a division superintendency on the Chesapeake & Ohio, to take effect Nov. 10.

Mr. William Buchanan, superintendent of motive power and rolling stock of the New York Central & Hudson River road, received a gold watch and chain last week from the veteran engineers of the road. The inscription included the two dates 1849–1889, Mr. Buchanan having been with the road forty years.

Mr. David A. Hopkins died of apoplexy at his home in Park Ridge, N. J., at two o'clock Thursday morning, Oct. 31, at 64 years of age. Mr. Hopkins is well known to the railroad public as the patentee and manufacturer of a lead-lined journal bearing, in which industry he had made a large fortune. He is also well known to a great number of working people for his kindness of heart and for the personal interest which he has always taken in their welfare, and for the liberality, both in money and in time, which he has shown in promoting their happiness. He will be remembered by all who knew him as a man somewhat eccentric, but of the greatest kindliness of disposition and of perfect rectitude.

We are gratified to learn that Mr. J. E. Phelan, master mechanic of the Northern Pacific at Mandan, has been appointed superintendent of the Missouri division of the same road. Five years ago Mr. Phelan was a locomotive engineer on the Northern Pacific, and nothing has pushed him upwards but the influence which every workman on American railroads may exert on his own career. This was the power which arises from energy and perseverance in acquiring a thorough knowledge of the duties his position required him to perform. Like most other successful men, he devoted his energies to the work he happened to be engaged on. As a first-class fireman he recommended himself for promotion as an engineer; as an excellent engineer he recommended himself for promotion as road foreman of engines; thorough competency in this position commended him for selection as division master mechanic; in the latter position he was so successful that his superiors needed him for a still higher office.



TRIPP BEARING.

The device of the skeleton frame for perfectly controlling the rolls, and holding the axis of them when out of duty, and bringing them into duty in perfect line with the axis of the shaft, is the great feature of the Tripp bearing over any other, as all rolls, when not so controlled, are required to be hardened, and even then do not run any length of time, and ruin the surface on which they bear. For rolls we use ordinary steel in the same state of hardness as when cut from the bar, and in our car bearings now running (from Boston to Philadelphia, making 381 miles daily, and a total service of over 57,000 miles to the present time), are not reduced $\frac{5}{1000}$ of an inch, and are uniform in size from end to end, thus showing the small amount of friction. The top of the box where the rolls bear most shows no depression whatever. The design of our thrust also has a beneficial influence on wear of rolls, as the side motion is controlled by a collar each side of an end thrust plate, and two leatheroid washers, one each side of thrust plate, between it and the collars in each box. The thrust plate is held firm by the outside cap when screwed on. The area of our thrust is 63 inches. and contact is on both ends of axle at the same time, while the M. C. B. standard axle has only 17 inches of thrust, and that only on one end at a time. The box is dust-proof, being packed on back end with packing having an expansive core, and holding the lubricating material free from dust and water without renewal during the life of an ordinary chilled wheel. Another important feature over the ordinary journal box is that when the brake is strongly applied the strain comes on rolls opposite brake shoe, causing no cramping whatever, and the axles run in box as free as ever, while the tendency of the brake on ordinary bearings is to crowd journal out of brass, and therefore reduce the bearing surface, and when brake is released and the journal is in the center of the box again, the surface being reduced is liable to heat.

The patentee of this bearing made a test of a two-inch bearing under a pressure of 400 pounds, running 6,000 revolutions per minute for two hours without lubrication or warming.

A set of these bearings have now run over two years, with one lubrication, under a 5,000-pound street car, with its usual number of passengers and with the usual number of times off the track, with no detrimental wear. A sleeve is used on the axle to increase size of journal and preserve it. There are now over twenty cars running with these bearings, giving perfect satisfaction; the bearing is also being applied to motors for street cars and stationary motors, shafting and various other devices, where it is desirous to have as little friction as possible.

Car 158 on the New York & New England Railroad equipped with the Tripp bearings commenced running Jan. 26, 1889, and up to Aug. 14, 1889, had made 19,937 miles. On that date the trucks were changed from under car 158 to car 156, and put on the run between Boston and Philadelphia, and up to Nov. 20 the bearings had made 57,650 miles. This car is now making 381 miles daily on the Washington fast express train.

In August a successful dynamometer test of the bearings then under car 158, was made in the yard of the New York and New England R. R., by J. B. Henney, superintendent of motive power, and other officers of the road, and in the presence of representatives of the Thomson-Houston Company and many others. The test on car 150 and car 156, before changed, of the master car builders' standard journals, showed a drafting strain of 600 and 800 pounds, respectively, and on the 12-wheeled Pullman car "Clypso," a strain of 700 pounds, averaging for the three cars 700 pounds.

Car 156, with Tripp bearings, was moved with a strain of 250 pounds, showing a saving power of over 60 per cent. in favor of the Tripp bearings. The car was warranted to run one year without any attention or additional lubrication.

A great many testimonials have been received from railroad companies, owners of machinery where the Tripp bearing is in use, testifying to its efficiency and economy.

The makers of this bearing also manufacture Tripp's celebrated metallic packing and Tripp's piston valve. The address of the company is Boston, Mass.

"The Century Magazine"

IN 1890—JOSEPH JEFFERSON'S AUTOBIOGRAPHY—NOVELS BY FRANK R. STOCKTON, AMELIA E. BARR AND OTHERS—A CAPITAL PROGRAMME.

During 1890 *The Century* Magazine (whose recent successes have included the famous "War Papers," the Lincoln History and George Kennan's series on "Siberia and the Exile System") will publish the long looked-for Autobiography of Joseph Jefferson, whose "Rip Van Winkle" has made his name a household word. No more interesting record of a life upon the stage could be laid before the public. Mr. Jefferson is the fourth in a generation of actors, and, with his children and grandchildren, there are six generations of actors among the Jeffersons. His story of the early days of the American stage, when, as a boy, traveling in his father's company, they would settle down for a season in a Western town, playing in their own extemporized theatre—the particulars of the creation of his famous "Rip van Winkle," how he acted "Ticket-of-Leave Man" before an audience of that class in Australia, etc.—all this, enriched with illustrations and portraits of contemporary actors and actresses, and with anecdotes, will form one of the most delightful serials *The Century* has ever printed.

Amelia E. Barr, Frank R. Stockton, Mark Twain, H. H. Boyesen, and many other well-known writers will furnish the fiction for the new volume, which is to be unusually strong, including several novels, illustrated novelettes, and short stories. "The Women of the French Salons" are to be described in a brilliant series of illustrated papers. The important discoveries made with the great Lick Telescope at San Francisco (the largest telescope in the world) and the latest explorations relating to prehistoric America (including the famous Serpent Mound, of Ohio) are to be chronicled in *The Century*.

Prof. George P. Fisher, of Yale University, is to write a series on "The Nature and Method of Revelation," which will attract every Bible student. Bishop Potter, of New York, will be one of several prominent writers who are to contribute a series of "Present-day Papers" on living topics, and there will be art papers, timely articles, etc., etc., and the choicest pictures that the greatest artists and engravers can produce.

Every bookseller, postmaster and subscription agent takes subscriptions to *The Century* ($4.00 a year), or remittance may be made directly to the publishers, THE CENTURY CO., New York. Begin new subscriptions with November (the first issue of the volume) and get Mark Twain's story, "A Connecticut Yankee in King Arthur's Court," in that number.

St. Nicholas.

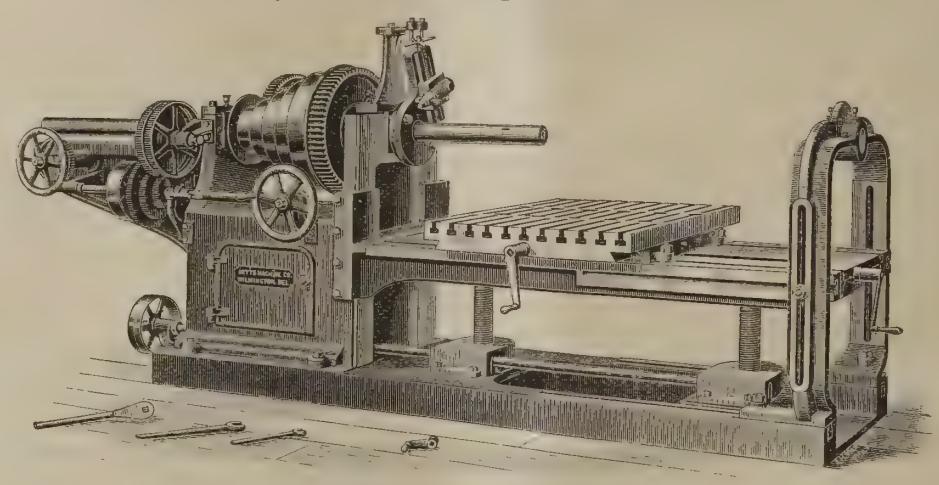
THE CENTURY COMPANY'S MAGAZINE FOR YOUNG FOLKS. ENLARGED AND PRINTED IN NEW TYPE.

Since 1873, when, under the editorial management of Mrs. Mary Mapes Dodge, the publication of *St. Nicholas for Young Folks* was begun, it has led all magazines for girls and boys. Nothing like it was known before, and to-day, as the Chicago *Inter-Ocean* recently said, "it is the model and ideal juvenile magazine of the world." Through its pages the greatest writers of our time are speaking to the youth of America and England, and the best artists and engravers are training the eyes of the boys and girls to appreciate the highest in art. Nobody knows how many readers *St. Nicholas* has. In the third largest public library in America—that in Indianapolis—more than 3,000 people read each month's number.

Since the first issue Mrs. Dodge has remained as editor. Early in its history other young people's magazines, *Our Young Folks*, *The Little Corporal*, *Riverside*, etc., were consolidated with it, and its history has been one of growth from the first. Tennyson, Bryant. Longfellow, Whittier, Miss Alcott, Mrs. Burnett, Charles Dudley Warner, W. D. Howells and almost every well-known writer of our time has contributed to its pages. There is only one way in which its conductors can make it better, and that is by making more of it; so they announce that with the beginning of the seventeenth volume (November, 1889) *St. Nicholas* will be enlarged by the addition of eight, and sometimes 16, extra pages in each number. This enlargement is absolutely required to make room for the rich store of new material which has been secured for the benefit of *St. Nicholas* readers. The use of new and clearer type will be begun with the November number.

During the coming year there are to be four important serial stories by four well-known American authors. Athletics and outdoor sports will be a special feature (contributed by Walter Camp, of Yale, and others), and there will be stories of character and adventure, sketches of information and travel, outdoor papers, articles of special literary interest, suggestive talks on natural history, other scientific subjects, and the march of events. Both the December and January numbers are to be holiday issues.

The price will be the same as heretofore, $3 a year, 25 cents a number, and all dealers and the publishers (The Century Co., New York) take subscriptions. New subscribers should begin with November.



HORIZONTAL DRILLING AND BORING MACHINE.

The accompanying illustration shows the No. 2 size of these machines, as built by the Betts Machine Company, of Wilmington, Del. This machine and the smaller size by this company are already well known to machine tool users, and have been most favorably received. The company in accordance with their usual policy have lately added several improvements which increase the capacity and convenience of these excellent tools.

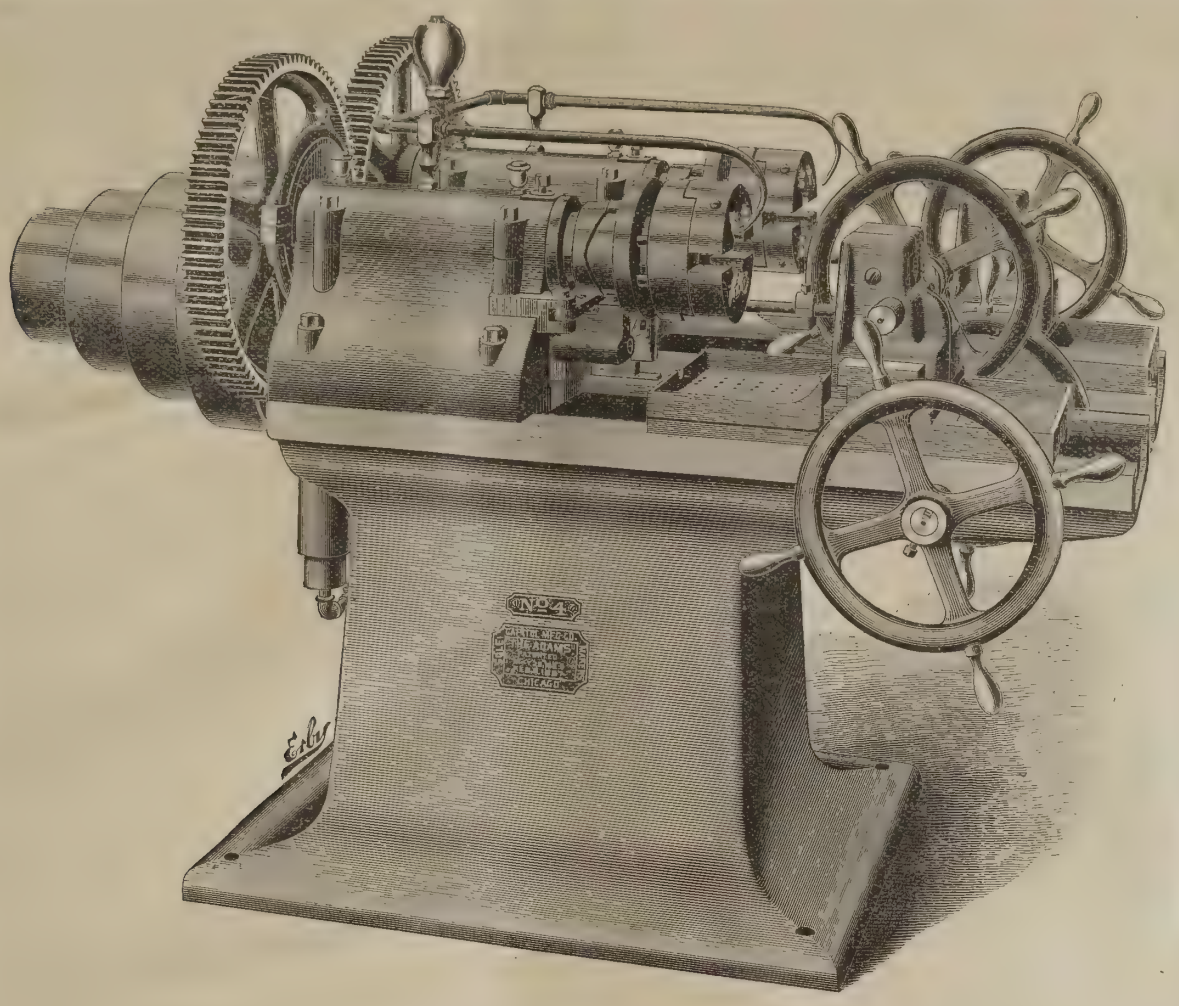
The driving cone has five speeds and is back-geared, giving ten speeds in either direction to the cast-iron shell through which the steel spindle has a full bearing and by which it is driven. The steel spindle is always provided with a set of properly proportioned feeds, automatic in action and instantly connected or disconnected as desired. Both a slow and rapid hand motion is also provided. The spindle after being fed through its full stroke can be left in position, while the feed slide is disconnected, moved back and secured to it at another point, thus enabling the machine to bore in length up to twice the ordinary capacity of the machine.

The spindle is provided with a truly-bored tapor hole to support one end of a boring bar while the steady rest carries the other end. The facing head fits on the end of the cast-iron driving shell and is driven therefrom; it in no way interferes with the free use of the spindle and both can be used at the same time. Any ordinary lathe tool may be used in it and the amount of room needed for its swing is constant and much less than in the older style, thus allowing the table to be set up closer to the spindle.

The long table is raised and lowered by power and is provided with the usual arrangement of compound tables on top of it. These tables are adjusted with screws, can be firmly clamped in position and are provided with ample means for securing work.

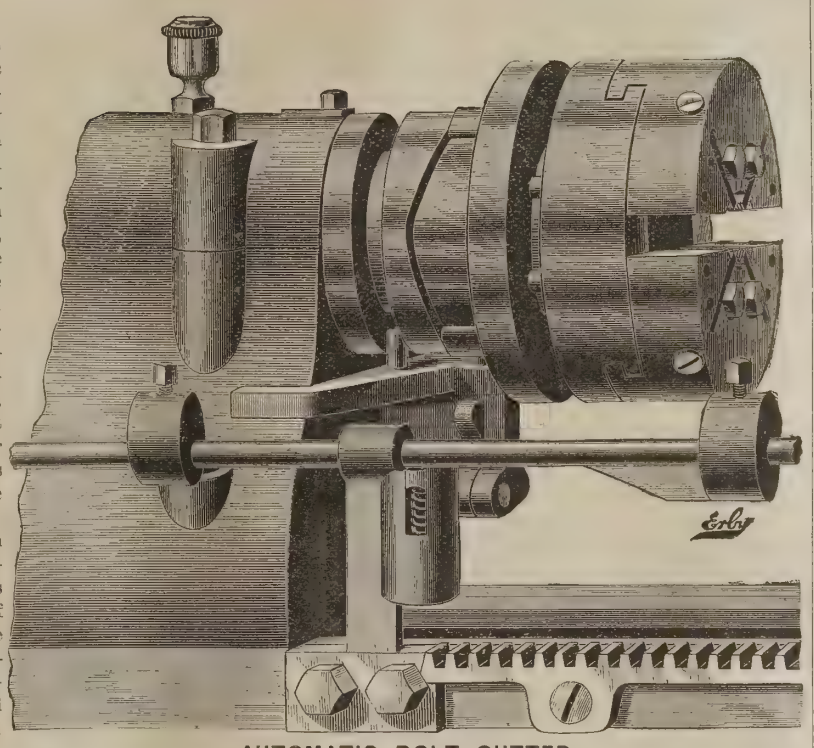
The machine is especially designed for handling a heavy duty with rapidity and accuracy, while at the same time it presents a neat and substantial appearance.

The builders will be glad to furnish, at any time, additional information to those desiring it.



The illustration represents the Double No. 4, or 1½-inch Adams Automatic Bolt-Threading and Nut-Tapping Machine. This machine is of an entirely new design and has been made from new patterns. The threading head and automatic device for opening and closing the same is the same as used on the smaller sizes of the Adams machine, except being larger in dimensions. The automatic device is absolutely positive in its operations and never fails to open or close the head for the purpose of releasing the bolt after it has been threaded, thus making stripping of bolts an impossibility. It is very simple and strong, cannot get out of order, and does not require the attention of the operator after the length of thread to be cut is adjusted by the opening collar on the rod attached to the sliding carriage.

The automatic consists of a cam groove on the head, a spring-seated actuating pin therein, and returning cams for said pin, all operated by the power of the machine, thus furnishing a positive and powerful but easy action. The operating action is controlled by the adjustable collar fixed on a rod attached to the sliding carriage, and operated thereby to release the actuating pin during the feed of the carriage, and the closing of the head is accomplished by the rear adjustable collar on the same rod operating a closing ever as the carriage is returned to position. The head is made entirely of steel and consists of four parts only: all wearing parts are made of the best hardened tool steel. The split head relieves the bolt when the thread is cut and permits the escape of the chips.



AUTOMATIC BOLT CUTTER.

The dies of this machine are removable and easily adjusted, but fixed and as rigid when adjusted as if set in a solid die machine. The dies being rigid and stationary whenever adjusted, neither they nor the movable working parts of the head are interfered with or worn by the action of the chips, nor are the chips drawn in or around them as in the open die machine. This machine has all the advantages of both the open and solid die machines, without the disadvantages of either They are, however, practically solid die machines, with the advantage of releasing the bolt after threading. Owing to the immovability and rigidity of the dies when adjusted, their life is much longer than those of either the open or solid die machines. There are no caps, cases, die-rings, levers, toggles or springs used in or about the cutter head, and the dies are very much cheaper than those used in any other machine, and the expense of keeping the dies in shape is comparatively small. The entire construction of the head is such that the wear on the same is altogether insignificant, and, if taken care of, will last a lifetime without needing repairs.

The dies are very simple and cheaply made and can be cut in a dummy head attached to any lathe, tempered and made ready for use, without occupying the cutter head for hobbing them out. This is an apparent advantage in many ways to manufacturers, especially to those who use a large number of machines, or those who desire to take full advantage of the capacity of the machine for threading purposes.

The dies, as will be seen, are clamped rigidly by means of the face screws; these screws have only to be loosened in order to remove or put in the dies. The face or clamp screws can be counter-sunk if so desired, permitting the threading of a bolt close to its head, which is necessary for a great variety of work; each die is independently adjustable, either way, by means of the adjusting screws shown.

The accurate adjustment of the die is made easy by means of a circle shown on the face of the head and completed by the arc of the same circle cut in the dies when they are hobbed or rehobbed in the dummy head to correspond. We always have a complete stock of standard dies on hand, tempered and ready for use, for those who do not care to cut their own dies. The steel for our dies is made especially for us.

The carriage, which is double the length of the ordinary carriage, is gibbed to take up the wear; the vise jaws are placed in the center of the carriage, in order to secure stability and accuracy.

All the machines are provided with an automatic force pump, which is operated by an eccentric and throws a steady and large stream of the lubricant into the head, thus lubricating the dies, as well as the bolt, and thereby assuring longer life to the dies, besides rendering the cutting easier. To insure a steady stream, an air chamber is attached to the feed pipe. The base of the machine is used as a reservoir, into which drains the oil thrown on the dies and bolts after being strained from the chips by means of a removable perforated chip-pan on the front of the carriage.

The base of the machine is made very heavy and all the bearings are very long. The cone pulley has four steps and is intended for a 4-inch belt; small step, 8 inches; large step, 16 inches; face, 4¼ inches; gears, 18 inches, P. D., with 90 teeth; pinion, 3⅜ inches, P. D., with 17 teeth; faces, 2⅛ inches, making a very powerful and easy running drive. All gears are cut from the solid and are as nearly noiseless as they can be made.

The nut taps or non-clamping attachment is arranged to admit of from two to four nuts on the cutting edge of the tap at one time, thus increasing the product three fold This feature is desirable only where the machine is used largely for nut as well as for bolt threading. The simplicity of the working parts of the machine as illustrated herein, is so apparent, that it is not thought necessary to give a detailed explanation of them, and in making valuable improvements, radical changes have also been made, and we are now prepared to still further substantiate the claim that in the improved machine manufacturers are assured of a threading machine unequaled in the mechanical excellence of its construction, durability, practical rapidity of its operation, and reliability in the uniformity of its product.

The workmanship on these machines is first-class in every particular, and special pains have been taken to have all parts well proportioned. We are manufacturing machines to cut bolts from ¼ inch up to 5 inches, and all machines to cut bolts larger than 3 inches have a geared vise.

We should be pleased to furnish catalogue and other description whenever it is required. Address, The Capitol Manufacturing Company, Chicago, Ill.

The Brazil Turnbuckle.

The turnbuckle which is shown in the accompanying cut is what is called the "Brazil" and is made by the Central Iron and Steel Company, Brazil, Ind., Anthony & McElroy, Philadelphia, Pa., general agents. It has the advantage of the hexagonal form which admits of a good wrench hold in any position; and being open, the ends of the rods may be seen and their position and condition ascertained at any time.



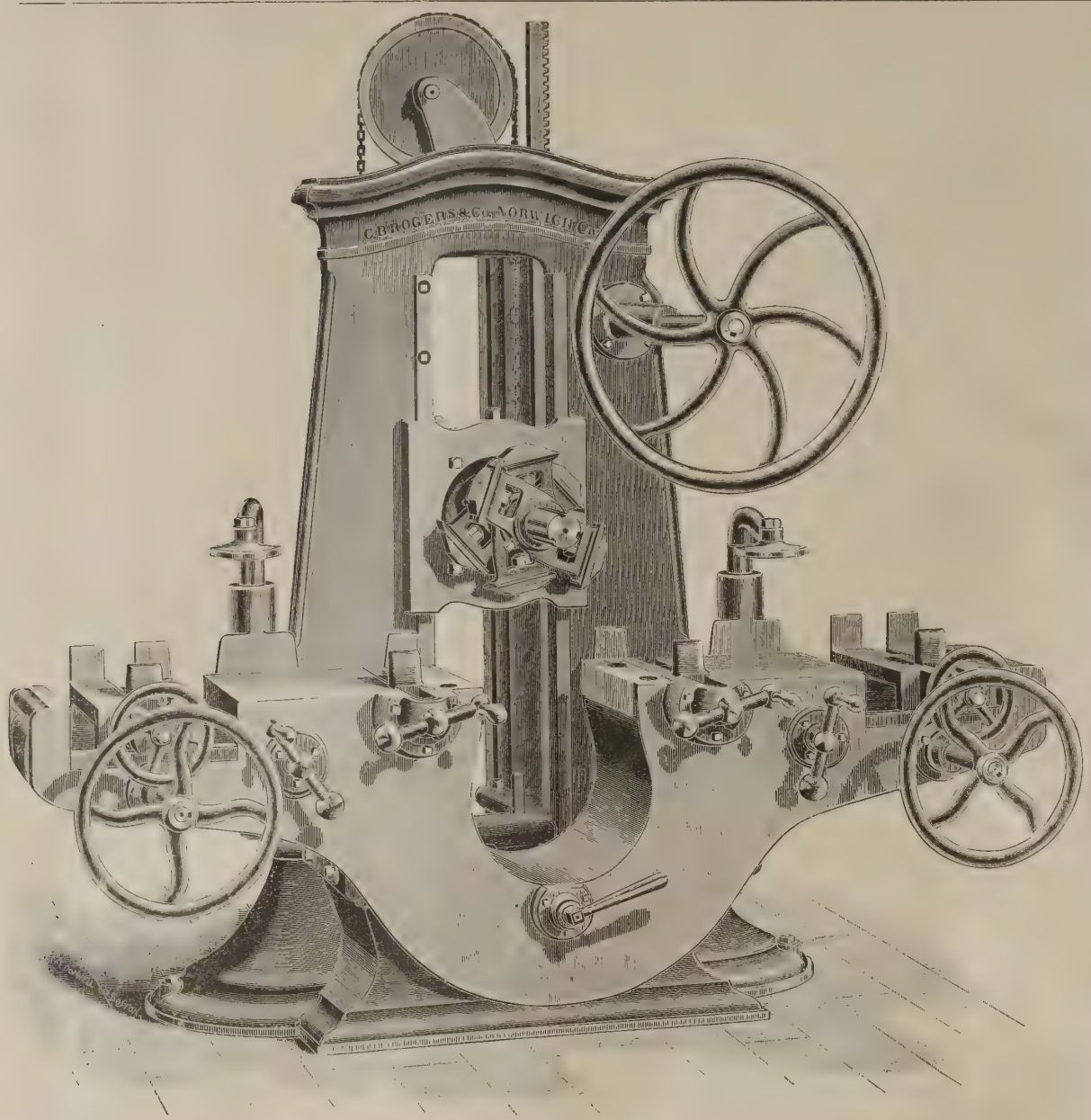
Tests of this turnbuckle have shown its reliability as to material and workmanship. A test was made by the Phœnix Iron Company with a 1¼-inch "Brazil" turnbuckle fitted to ordinary stub ends. A stub broke at 57,600 pounds per square inch, but the turnbuckle was uninjured. In a test of a 1¾-inch buckle fitted with Krupp steel stub ends at the shops of the Chicago & Northwestern, the stub broke at 82,000 pounds, but the turnbuckle was not injured. Other tests made in comparison with other turnbuckles have shown the good qualities of the "Brazil," and we are told that it is to be adopted by some of the larger bridge works. The Pennsylvania Railroad Company tested a 1¼-inch buckle which broke the stubs of steel at 82,000 pounds, the buckle being uninjured.

Phœnix Iron Company are buying these buckles right along. J. G. Brill Car Company has given a large order, and they have sold them to other parties in Philadelphia and Boston.

The business carried on heretofore at Springfield, Mass., under the style of the Springfield Glue and Emery Wheel Company, has been transferred to the Springfield Emery Wheel Manufacturing Company, a corporation which has assumed all the liabilities of the former company, and is authorized to collect and receipt for all debts due it. New works are now under way at Bridgeport, Conn., where the business will be moved about Feb. 1, 1890.

Until the last few years the consumption of North Carolina pine was confined to a very small territory outside of the South, but since the general adoption of dry kilns it has found its way into the principal yards in the North, East and West, and is now as essential as white pine. Not the least of its uses is in the construction of freight cars, under the name of Norfolk siding. Its freedom from knots and shakes, its durability and strength of material, together with the great saving in cost, makes it a most desirable wood for that purpose. Some of the largest shops in the country are using it exclusively for flooring, siding, ceiling, or lining and roofing. The Tunis Lumber Company, of Baltimore, Md., are doing a large business with this lumber, having the control of it. They have already introduced it into twenty different States.

"Apt alliterations artful aid" appears to naturally and automatically couple the name of Valentine with that of varnish, and medals and diplomas appear to follow it wherever exhibited. Without claiming for it right off the real pre-eminence over all other varnishes, there must be something intrinsically good about a production that has obtained official recognition at exhibitions in places so widely apart as Philadelphia, Paris, Amsterdam, Melbourne, Adelaide, New York, Massachusetts and New Orleans within the last 13 years, and many other places before that. They have also been awarded a medal at the present Paris Exhibition, in addition to which they claim that out of 175 carriages exhibited 108 were varnished with Valentine's varnish, and also that all the four exhibitors who received 'Grand Prix" used Valentine's varnish on the carriages which earned the distinction. The "artful aid" of persistent, skillful and expensive advertisement has long been used by Messrs. Valentine to help spread the fame and the use of their varnish, or, rather, varnishes, for they make many sorts, applicable to many and various uses; but unless, also, the stuff is good no permanent good can come of puffing, for nothing so quickly reveals itself as regards excellence of quality, or the reverse, as carriage varnish. A badly varnished carriage, or a carriage varnished with bad varnish, is so patent to even the uninstructed eye that even "he who runs may read." It may, therefore, be very safely concluded that what so many say must be true, and that Valentine varnish really is a first-rate article.—*Carriage Builders' Gazette.*



NO. 0 VERTICAL CAR TENONING MACHINE. TO CUT DOUBLE TENONS.

This new and valuable machine is designed to meet the wants of car-builders and railroad shops, being adapted to tenoning car-sills, and timber up to 16 inches square, and any extra heavy work. The machine is very heavy, made entirely of metal, and in a most workmanlike manner. The working parts are: A table on which the timber is laid, and held in place by improved adjustable clamping screws, which are instantly set by the cranks in front. The bed also adjusts to and from the column by the screw at the base, and is provided with a movable section on either side of the cutter head for end adjustment of the timber to the cutters.

The cutter heads consist of three sectional heads, of cast steel, cutting tenons 4 inches long, adjustable to any distance apart on their arbor, which runs in a frame gibbed to the column, and is balanced by a weight, the whole moving freely in a vertical direction by the operation of the large hand-wheel in front.

The timber to be worked, being clamped to the movable section of table, is by means of the hand-wheels moved endwise to proper relation to the cutter head. The latter in its downward motion cuts the tenons on one end; and the timber being moved laterally on the table, and clamped, and the head in its upper movement cuts the opposite end. A gauge is provided on the table to set the work by. The machine should rest on a solid foundation, which may be made five feet square for the base. A counter-shaft and standard are furnished with the machine.

The tight and loose pulleys on counter are 12-inch diameter, 8-inch face, and should make 400 revolutions per minute, giving 1,600 to the head. Weight of machine, 5,800 pounds. Power required to drive vertical tenoner, 8 horse-power. Belting required, 25 foot of 8-inch belt. Driving belting should be 8-inch. Manufactured by C. B. Rogers & Co., Norwich, Conn.

The Pittsburgh & Western Railroad Company are building 1,500 new freight cars and equipping them with the American continuous drawbar. This useful attachment is also being applied to 900 cars under construction for the Cincinnati, Washington & Baltimore. The Ohio River Railroad Company have bought the right to apply the drawbar to all their cars.

The motion for an injunction in the case of the Bridgeport Wood Finishing Company vs. The New York Wood Finishing Company, came on to be heard before his Honor Judge Wheeler in the Circuit Court for the Southern District of New York, Friday, November 15th, and was argued by S. J. Gordon, Esq., for the complainant and Albert Comstock, Esq., for the respondent. The judge reserved his opinion, but handed it down the next day, sustaining the Wheeler Patent and ordering the injunction to issue.

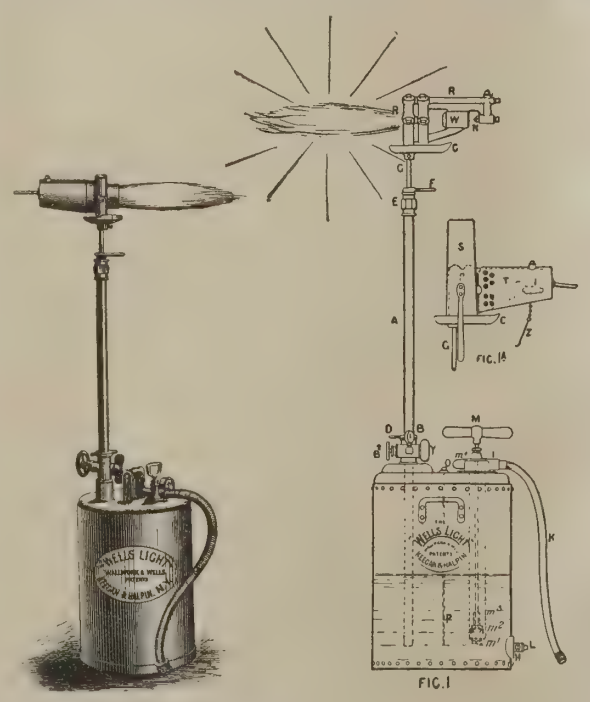
We have received a copy of the fall circular of second-hand locomotives and cars belonging to Regnald Canning & Co., New York. The list embraces a vast variety of locomotives and all sorts of cars. This company have lately bought a large lot of passenger and combination cars and are now prepared to furnish railroad companies with every kind of rolling stock for standard or narrow gauge. They are also prepared to make any altera tions required on rolling stock and to sell on the car trust plan if desired. Railroad companies in want of rolling stock would do well to look into this list.

The Wells Light.

The Wells light, which we describe in the following article, and which is being put upon the market by Messrs. Keegan & Halpin, Washington street, New York, is an invention which has met with great success in England; and which, judging if all that is claimed for it is true, should do equally well here.

It is an industrial light, intended for use out of doors in any weather or in-doors for large, heavy work.

The light is produced from kerosene oil, which is contained in the steel tank shown in the engraving, and raised to the burner by pneumatic pressure. This pressure is obtained by



a hand pump fitted in the crown of the lamp, and which is so constructed as to force either oil or air into the tank. When oil is forced in the air above it is compressed until a pressure of about 20 pounds is obtained. This pressure will continue to raise the oil for about four hours, by which time it will have fallen to about eight or nine pounds, and needs renewing by a short application of the pump.

The burner on the top of the stand pipe is heated at starting by burning a little oil in the dish shown beneath it; when hot the valve is opened, and the oil coming into the burner is changed into vapor, and burns in a powerful, horizontal flame, which keeps the generating tubes hot. The light will stand any weather, since the horizontal direction of the flame enables it to be swiveled to run down wind; while the heating surface in the burner being large, it is unaffected by rain.

The lamp is well worked out; the pump, being placed inside, is protected from injury, and every part is easily accessible for cleaning and repairs. As will be understood from the foregoing description, however, the whole thing is so simple that a very small amount of attention is required, and it may be safely put into the hands of any laborer.

In locomotive and car works its chief use will, we fancy, be in the foundry for mold-breaking, partial overtime, when it does not pay to run the electric light plant; in the yards for loading and in the heavy forge and plate-bending mills. In the foundry or boiler shop half of the work is frequently in shadow, however well lighted the shop may be, and a light which can be moved around the job exactly where it is required cannot fail to be of service. Besides, this, should a breakdown occur in any part of the works, powerful light is immediately required, and up to now has been unattainable.

For outside work the uses of the light appear to be endless, judging from its use on all the principal railroads in their break-down gangs, and a special size is being made in this country for wreck-clearing. This size has a very light tank, about 20 by 14 inches, and a powerful burner, giving a flame about three feet long. The weight complete and full of oil being about 170 pounds. This should be a valuable adjunct to every tool car.

Want of light has always been the chief drawback to the rapid clearance of wrecks. It is also adapted for tracklaying, general repairs and maintenance, and many railroad men must have seen this light in use on the Manchester Ship Canal in England, where the whole of the night work is carried on by the aid of about 200 of them.

The light here is made in three sizes.

1st. The railroad lamp described above.

2d. The ordinary standard Wells light, which has a larger tank and a less powerful burner, but one which gives a light large enough for thirty or forty men to work by.

3d. A small hand lamp weighing 70 pounds, fitted with one handle on the top of the tank. This can be carried by one man, and gives a light of about 500 candle power. It is on exactly the same principle as the larger size, and is shown in the accompanying illustration.

The strong feature of the lamp is the fact that it needs no outside power of any kind to drive it, but is absolutely self-contained and therefore portable. We see no reason why it should not have a great success here, and engineers would be wise to give it, at any rate, a trial.

We have received from the A. French Spring Co., Pittsburg, a beautifully illustrated description of the company's works printed in Spanish. This language was not used for our edification but for that of the Pan-American delegates who lately visited the highly interesting establishment. Each of them was presented with a copy of the pamphlet as a souvenir of the visit.

We have seen the figures given by Professor Smith, of Mason College, Birmingham, England of tests of magnolia metal. One is quite remarkable; pressure, per square inch, 1,659 pounds; 150 revolutions per minute; run of 2 hours and 45 minutes highest temperature "hand warm." This pressure is over three times that of the heaviest merchant steamship or warship and revolutions about twice.

The engine sales reported by the Westinghouse Machine Company have reached high-water mark during the month of October, 1889. They are the largest in the company's history, and are as follows:

35 junior engines	1,095 H. P.
32 standard engines	1,395 "
43 compound engines	3,545 "
110 engines, aggregating	6,035 "

Our Directory.

We note the following changes since our last issue. Our readers will do us a great favor by giving us prompt notice of any changes that may come to their knowledge of any error that may be noticed in our list.

Columbus, Hocking Valley & Toledo.—Charles H. Rockwell has been appointed general superintendent, with headquarters at Columbus, O., in place of G. R. Carr, resigned.

Duluth, South Shore & Atlantic.—Russell Wallace having resigned; P. W. Brown has been appointed purchasing agent of this company.

Lake Shore & Michigan Southern.—H. P. Latta has been appointed master mechanic of the Toledo Division, with office at Norwalk, O., vice J. M. Sanborn, resigned.

Mexican National Construction Co.—Mr. W. I. McCammon, formerly master mechanic of the Southern Division of the Mexican National, has accepted a similar position on the Colima Division of this company.

New York & New England.—George N. Farley has been appointed superintendent of the Western Division, in place of C. H. Platt, resigned. His headquarters will be at Hartford, Conn.

Northern Pacific —Mr. J.E.Phelan, master mechanic, Mandan, has been appointed superintendent of the Missouri Division.

Sioux City & Northern.—J. G. Butterfield has been appointed master mechanic, with office in Sioux City, Ia.

South Carolina.—C. M. Ward has been appointed general manager in place of Col. John B. Peck.

Ohio, Indiana & Western.—Mr. Hunter Gunnell has resigned as purchasing agent.

Employment.

WANTED.—Reliable Western or Southern ex-railroad man to sell our brasses and bells. (Bells cannot crack nor break, and have richest tone.) We make brasses of all descriptions. Prefer a man having extensive acquaintance and sell on commission. Address, Standard Journal Bearing Co., 105 Jefferson street, Chicago.

WANTED.—Situation as foreman boiler maker in a railroad shop. Best of references. Address J. T. Connelly, Box 166, Huntington, W. Va.

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